

SOUTHERN CALIFORNIA TRACON
ETG LAB
SAN DIEGO, CA

TECHNICAL SPECIFICATIONS
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SECTION 01045 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for cutting and patching.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 2 Section 02070 "Selective Demolition" for demolition of selected portions of the building for alterations.
 - 2. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - a. Requirements of this Section apply to mechanical and electrical installations. Refer to Divisions 15 & 16 for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures well in advance of the time cutting and patching will be performed if the Owner requires approval of these procedures before proceeding. Request approval to proceed. Include the following information, as applicable, in the proposal:
 - 1. Describe the extent of cutting and patching required. Show how it will be performed and indicate why it cannot be avoided.
 - 2. Describe anticipated results in terms of changes to existing construction. Include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
 - 3. List products to be used and firms or entities that will perform Work.
 - 4. Indicate dates when cutting and patching will be performed.
 - 5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
 - 6. Where cutting and patching involves adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with the original structure.

7. Approval by the Architect to proceed with cutting and patching does not waive the Architect's right to later require complete removal and replacement of unsatisfactory work.

1.4 QUALITY ASSURANCE

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio.
 1. Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements:
 - a. Structural steel.
 - b. Structural decking.
 - c. Miscellaneous structural metals.
 - d. Piping, ductwork, vessels, and equipment.
- B. Operational Limitations: Do not cut and patch operating elements or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements or related components in a manner that would result in increased maintenance or decreased operational life or safety.
 1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:
 - a. Primary operational systems and equipment.
 - b. Air or smoke barriers.
 - c. Water, moisture, or vapor barriers.
 - d. Membranes and flashings.
 - e. Noise and vibration control elements and systems.
 - f. Control systems.
 - g. Communication systems.
 - h. Electrical wiring systems.
- C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities. Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. Remove and replace construction cut and patched in a visually unsatisfactory manner.

1.5 WARRANTY

- A. Existing Warranties: Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.
 - 1. Before proceeding, meet at the Project Site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Avoid cutting existing pipe, conduit, or ductwork serving the building but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

- A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction using methods least likely to damage elements retained or adjoining construction. Where possible, review proposed procedures with the original Installer; comply with the original Installer's recommendations.

1. In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
 3. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.
 4. Comply with requirements of applicable Division 2 Sections where cutting and patching requires excavating and backfilling.
 5. Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.
- C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
 2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Where removing walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch after the area has received primer and second coat.
 4. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.4 CLEANING

- A. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

END OF SECTION 01045

SECTION 01110 SUMMARY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, other Division 1 through Division 16 Specification Sections, and any Special Provisions or attachments to this Contract apply to this Section.

1.2 DEFINITIONS AND ACRONYMS

- A. These Specifications, together with referenced specifications, standards and drawings specified in the Contract Documents, cover the requirements of Contractor and Federal Aviation Administration (FAA) for the Work.

DEFINITIONS, ACRONYMS, ABBREVIATIONS, AND REFERENCES:

Contract Documents All documents that, together, constitute the contract. "Contract Documents" refers to the contract between the FAA and the contractor. Refer to OOP clause 3.2.2.3-60.

GFE/GFP/GFM Government Furnished Equipment/Property/Material.

NTP Notice to Proceed.

Quality Conformance to the requirements established by the contract specifications and drawing.

Record Documents Drawings, Specifications, Addenda, Change Orders and other Modifications; also approved Shop Drawings, Product Data, Samples, and similar submittals required to be provided by Subcontractor.

Record Drawings Drawings submitted by the contractor to show the construction of a particular structure or Work as actually completed under the Contract.

Request for Information (RFI) The method used by the Contractor to document and transmit field generated technical issues relating to design and construction of the Project.

RFO Request for Offer.

Schedule of Values The method used by the Contractor to allocate values to various portions of the Work that, when approved by the government, provides the basis for contractor's application for payment.

Shop Drawings Specific drawings, schedules, diagrams, and other data prepared for this Contract by the Contractor, their lower tier subcontractors, manufacturers, suppliers, or distributors, to illustrate a portion of the Work.

Site, Jobsite, or Worksite Refer to premises associated with this Project.

SSSP Site Specific Safety Plan.

Contract The written Contract executed between the government and Contractor.

Contractor The entity, and all of its lower tier subcontractors, identified as such in the Form of Agreement of the Contract.

Submittal A submittal is a Contractor's or manufacturer's drawing, brochure, sample, certificate, warranty, or other material which provides detail for construction and quality control of the permanent Work and includes deliverables such as schedules, product cut sheets, Work procedures, or product samples that are required under the terms of the Subcontract.

Test Plan A detailed step-by-step procedure for testing major equipment and systems.

Test Results Documentation of specified quality assurance test results.

Work or Services Includes, but is not limited to, labor, materials, workmanship, manufacture and fabrication of components, and actions necessary for the performance of this Contract, and is the sum of all activities, products, and services, whether or not accomplished specifically at the project site, imposed on or elected by the Contractor to complete the performance and delivery requirements of the Subcontract.

1.3 SUMMARY OF WORK

A. General:

This specification, along with related documents specified in Paragraph 1.1, covers the requirements for all work associated with Architectural, Structural, Mechanical, and Electrical Upgrade for the SCT, in San Diego, CA. Additional labor, materials, equipment, and/or appurtenances not specifically detailed or specified, but required to complete the project, shall be provided by the Contractor as an integral part of the scope of work specified.

B. Major Items of Work:

The following items are a brief summary of the project and are provided solely for the purpose of revealing the general nature of the work involved.

- Furnish and install gypsum board assembly.
- Demolish existing gypsum board assembly.
- Paint and patch gypsum board assembly to match existing.
- Furnish and install structural steel support frame for gypsum board assembly.
- Furnish and install supply air plenum with grilles.
- Paint plenum and all grille surfaces with semi-gloss enamel to match color of existing supply plenums.
- Furnish and install new smoke detectors and connect to existing fire alarm system. Smoke detectors to match existing detectors type and model.
- Furnish and install sprinkler if existing spacing exceed allowable.
- Furnish and install lighting and receptacles.

The Contractor is responsible for accomplishing all items of work in accordance with the applicable drawings, specifications and provisions of the subcontract. Any additional labor, materials, equipment, and/or appurtenances not specifically detailed or specified, but required to complete the project, shall be provided by the Contractor as an integral part of the scope of work specified. This information should not be used solely as a basis for Contractor's proposal.

1.4 SAFETY AND SPECIAL PRECAUTIONS

- #### A.
- Contractor shall develop and submit a SSSP for approval 5 days after Notice of Award. Construction shall not commence until the SSSP has been approved by the SA. The Contractor shall comply with safety, health, and emergency response provisions for this contract, in accordance with *Sections 00840 Safety Requirements, 00843 Workplace Safety and Health, and 00845 OSHA Safety Requirements*, and the *American Federation State County Municipal Employees Health and Safety*.

1.5 QUALITY

- #### A.
- Contractor shall develop and submit a Contractor Quality Control Plan (QCP) for approval 5 days after Notice of Award. Construction shall not commence until the QCP has been

approved by the SA. The Contractor's QCP shall comply with the requirements of Section 1-6, Quality Control and the Contract Documents. Specification Sections requiring certified independent testing agency services include, but are not limited to, the following:

1. Section 05120 Structural Steel
2. Section 09255 Gypsum Board Assemblies
3. Section 09900 Painting
4. Section 15010 General Requirements for Mechanical Work
5. Section 15050 Basic Mechanical Materials and Methods
6. Section 15891 Metal Ductwork
7. Section 15910 Duct Accessories
8. Section 15932 Air Outlets and Inlets
9. Section 15933 Air Terminals
10. Section 15970 HVAC Controls
11. Section 15990 Testing, Adjusting, and Balancing
12. Section 16050 Basic Electrical Materials and Methods
13. Section 16100 Raceways, Boxes, and Cabinets
14. Section 16111 Cable Trays
15. Section 16120 Wires and Cables
16. Section 16140 Wiring Devices
17. Section 16190 Supporting Devices
18. Section 16452 Grounding
19. Section 16470 Panelboards
20. Section 16515 Interior Lighting

1.6 PROJECT SCHEDULE

- A. Contractor shall develop and submit to the Contractor a preliminary Construction Progress Schedule (Schedule) and preliminary Schedule of Values for approval 5 days after Notice of Award. The Contractor's approved Schedule of Values and Schedule are conditions for payment. The Contractor's Schedule shall comply with the requirements of Section 1-4, Construction Progress Schedule. The Contractor shall provide the following information with the Schedule:
 - 1) Activity for each major portion of work.
 - 2) No fewer than 25 Activities.

1.7 PRE-CONSTRUCTION MEETING

- A. The Contracting Office will schedule a pre-construction meeting after Notice of Award. Required attendance includes Contractor, Contractor's Superintendent, and major lower tier subcontractors. An agenda will be provided but shall include the review of the SSSP, QCP, Schedule, and Schedule of Values. The Contractor shall submit other items identified in Section 1-2.3 at the Pre-Construction Meeting for review at the meeting. Acknowledgements of all the reviews made at the session shall be noted in the meeting minutes. the government will designate a representative at the meeting to keep the minutes and is responsible for distribution.

1.8 ACCESS REQUIREMENTS

Facility Requirements: As required by Southern California TRACON Personnel & FAA
Security Requirements: As required by Southern California TRACON Personnel & FAA
Parking: TBD
Consideration for Facility Users/Tenants: TBD

- A. General Access and Use. Access to the work sites shall be with approval of Resident Engineer. Access to the work sites shall be thoroughly discussed prior to the actual start of actual construction. Only vehicles essential to the construction effort shall be permitted in the construction area.
- B. Access to certain locations for the project may be restricted due to base operations. Contractor may be required at various times to yield to airport operations that may require use of the Site. Upon receiving such a notice, Contractor shall vacate the subject area. Unless otherwise indicated, Contractor shall have complete and exclusive use of the premises within the construction staging area limits for the execution of the Work.

1.9 CONTRACTOR AND GOVERNMENT FURNISHED PROPERTY

These Specifications identify labor, materials, plant and equipment to perform the Work. All material not specifically indicated as furnished by Government as indicated in Section 1-1.9 shall be furnished by Contractor.

- A. Government Furnished Equipment/Government Furnished Property. - The Contractor shall be accountable for all GFE/GFP or equipment/property acquired under this Contract. The Contractor shall not accept any GFE/GFP without documentation signed by both the Contractor and Government indicating actual items and quantities received/transferred. GFE/GFP furnished but not installed will be returned to the Government with documentation signed by both the Contractor and Government indicating actual items and quantities received/transferred. The Contractor shall adequately control, preserve, protect and maintain all GFE/GFP and Contractor acquired property.

1.10 COMPLIANCE WITH LOCAL AND OTHER CODES AND REQUIREMENTS

- A. The Contractor shall be responsible for coordination of all work at the jobsite, and for obtaining local permits. The Contractor shall obtain and comply with any necessary licenses/permits that comply with applicable Federal, State, and Municipal regulations in connection with the scope of the work. The Government shall not be required to pay any amount for any action taken by a state or political subdivision. All electrical work is to be performed by a licensed electrical contractor from a recognized jurisdiction having authority on local unions.
- B. Refer to the American Federation State County Municipal Employees Fact Sheets for Welding Hazards.

1.11 GOVERNMENT RIGHT OF ACCESS

- A. The Government reserves the right to enter the premises during the term of the Contract for quality assurance work inspections and/or maintenance of existing navigational and communication facilities.

1.12 SITE INSPECTION

- A. After NTP and prior to initiating Work, Contractor and Resident Engineer shall conduct joint inspections of the jobsite to determine the existing conditions and note any existing damage or defects. Existing damage or defects will be used as the basis for determination of damages caused by the Contractor's operations.

1.13 SITE DAMAGE

- A. Contractor shall be responsible for the cost of any repair caused by Contractor's operations or the operations of its subcontractors. All damage to the existing Site including, but not limited

to, existing utilities and cables, facilities, equipment, buildings, and vegetation shall be repaired. All such repairs shall match the original finish and shall be made utilizing materials, equal to or greater than the original materials, as approved by Resident Engineer. All repairs shall be made with no additional cost to Government.

PART 2 PRODUCTS [NOT USED]

PART 3 EXECUTION

3.1 SPECIAL SCHEDULING REQUIREMENTS

- A. Protect existing facilities and equipment from physical or electrical damage as a result of accidental or incidental negligence, such as, but not limited to, disruption of standby power to the facility or equipment.
- B. All preparatory work shall be completed by the Contractor prior to shutdown/cutover to minimize downtime. The requested time and date of shutdown and cutover shall be approved by the Resident Engineer a minimum of two (2) working days in advance of the requested shutdown or cutover. Government personnel will perform the actual shutdown/cutover of systems that affect operations.
- C. In the event any services are interrupted, restore services with a full crew on a 24-hour basis, including Work during holidays and weekends, at no additional cost to the Government or delay to the Contract completion date.
- D. Request any utility interruptions in writing VERIFY: five days before the scheduled interruption, unless otherwise specified. Resident Engineer review is required before interruption. In this notification, the Contractor shall certify that all equipment, materials, and personnel necessary to conduct such testing will be available on the scheduled date and that the systems have been pre-checked by personnel and are ready for performance and acceptance testing.
- E. Contractor shall also confirm that all operations and maintenance manuals have been submitted and approved. No performance and/or acceptance testing will be permitted until the operations and maintenance manuals have been approved.
- F. At the option of the Government, Government personnel will travel to the site to witness testing. If the testing must be postponed or canceled for whatever reason not the fault of the government, the Contractor shall provide the Government not less than three (3) working days advance notice (notice may be facsimile) of this postponement or cancellation.
- G. Coordinate all required outages with the Government through the Resident Engineer. The Contractor shall determine quantity and duration of outages required to complete the work. The Contractor may have to schedule their work and outages at a time when air traffic is at a minimum. This could mean late night or early morning hours.
- H. Do not interrupt services outside of permitted, scheduled outage periods.

3.2 INSPECTION OF WORK

- A. Government retains the right to inspect all Work on the project, but has no obligation to do so. Government inspections and tests are for the sole benefit of Government and do not:
 - 1. Relieve the Contractor or its lower tier contractors of the responsibility to provide adequate quality control measures;
 - 2. Relieve the Contractor or its lower tier contractors of the responsibility for damage to or loss of material before acceptance; or
 - 3. Constitute or imply acceptance.

- B. The presence or absence of the Resident Engineer does not relieve the Contractor or its lower tier contractors from any Contract requirement, nor is the Resident Engineer authorized to change any requirement of the Contract.

3.2 SUBMITTALS

- A. Document, data, and/or material submittals shall be in accordance with Section 01300 SUBMITTALS and/or as specified elsewhere in the Technical Specifications.

3.3 CONTRACT CLOSEOUT

- A. The Contractor is responsible for Contract closeout in accordance with Section 01730 CONTRACT CLOSEOUT.

END OF SECTION

SECTION 01300 – SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY:

- A. Furnish submittals as required by the individual sections of the specifications in accordance with this Section.

1.3 QUALITY ASSURANCE:

- A. Submittals, including shop drawings, are the Contractor's sole responsibility. Carefully examine submittals to ascertain that all provisions of the specifications have been complied with.
- B. Submit descriptive data, certificates, performance data, test results and other information necessary to ascertain the quality of the component and its suitability for the purpose intended. The Contractor shall make, without cost to the Construction Manager, any change or adjustment in correcting work resulting from the use of such optional material or construction in conformity with the contract requirements.

1.4 DEFINITIONS:

- A. For the purpose of defining the meaning of scheduled submittals, the following descriptions shall apply:
 - 1. Shop Drawings (SD): Include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings.
 - 2. Certified Test Reports (CTR) - A report prepared by an approved testing agency giving results of tests performed on products to indicate their compliance with the specifications. (Refer to Section 01400, "Quality Control").
 - 3. Certification of Local Field Service (CLS) - A certified letter stating that field service is available from a factory or supplier approved service organization located within a 300 mile radius of the project site. List names, addresses, and telephone numbers of approved service organizations on or attach to the certificate.
 - 4. Extended Service Agreement (ESA) - A contract to provide maintenance beyond that required to fulfill requirements for warranty repairs, or to perform routine maintenance for a definite period of time beyond the warranty period. Issue the service agreement in the name of the Construction Manager.
 - 5. Certification of Adequacy of Design (CAD) - A certified letter from the manufacturer of the equipment certifying that they have designed the equipment to be structurally stable and to withstand all imposed loads without deformation, failure, or adverse effects to the performance and operational requirements of the unit. The letter shall certify that the mechanical and electrical equipment is adequately sized to be fully operational for the conditions specified or normally encountered by the product's intended use.

6. Certification of Applicator/Subcontractor (CSQ) - A certified letter stating that the applicator or subcontractor proposed to perform a specified function is duly designated as factory authorized and trained for the application of the specified product.
7. Record Drawings (RD)- General information including character, style and product data sheets, wiring diagrams, and other data normally available as published material by manufacturer. (Record drawings will not be required if shop drawings are provided for the specific component)
 - a. Product Data: Where product data includes information on several products that are not required, mark copies to indicate the applicable information:
 - 1) Manufacturer's printed recommendations.
 - 2) Compliance with trade association standards.
 - 3) Compliance with recognized testing agency standards
 - 4) Application of testing agency labels and seals.
 - 5) Notation of dimensions verified by field measurement.
 - 6) Notation of coordination requirements.
8. Operational and Maintenance Manuals - Refer to Section 01730 "Operation and Maintenance Manuals/ Record Documents."
9. Equipment Installation Report - A report by the manufacturer's representative or installer, stating that equipment has been installed in accordance with manufacturer's requirements and has been operated or otherwise tested and functions properly, fulfills the requirements of the Documents. Include copies of Test Report Forms as required by the Construction Manager.

1.5 SUBMITTALS:

- A. Submittals shall adhere to the procedures outlined herein. Submittals must be complete or they will be returned without review. Do not submit partial or incomplete information. Shop drawings are drawings, submitted to the Construction Manager by the Contractor, showing in detail (1) the proposed fabrication and assembly of structural elements, and (2) the installation (i.e., fit, and attachment details) of materials or equipment. Shop drawings may also include drawings, diagrams, layouts, schematics, descriptive literature, illustrations, manufacturer's brochures, schedules, performance and test data, and similar materials furnished by the Contractor to explain in detail specific portions of the work required by the contract. The Construction Manager may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.
- B. Submittals shall be accompanied by an original and one copy of transmittal letter that identifies the content of the submittals.
- C. Submit a minimum of eight (8) sets of shop drawings and/or brochures, or other submittals, or preferably two (2) sets of blueline prints and one (1) set of reproducible sepias in lieu of the eight (8) sets of blueines. Two (2) sets of shop drawings will be returned to the Contractor. Submit complete sets of indexed and bound product data.
- D. Submit color charts and samples for every item requiring color, texture or finish selection. Color charts and samples shall be submitted together. No color will be selected until all material selections are submitted. Review the drawings and specifications, ascertain items that require color selection and submit data not less than within thirty (30) days prior to first need. Subsequent to receipt of color samples the Construction Manager will select colors, and issue color selections for all products.

1.6 SUBMITTALS PRIOR TO NOTICE TO PROCEED:

- A. Submit the following information to the Construction Manager within fifteen (15) days after award of contract. Notice to Proceed (NTP) will not be issued until these submittals are approved.
 - 1. Shop Drawings required prior to NTP are identified by an asterisk (*) in the Schedule of Submittals located at the end of this Section.

1.7 SAMPLES:

- A. Submit samples where indicated in the specification and as requested by the Construction Manager. After review and approval by the Construction Manager, samples will be returned and may be incorporated into the construction, except that samples that are to be used to judge quality of work will be retained until the work has been completed and approved.
- B. Submit two (2) samples whenever samples are requested. Samples will be accompanied by descriptive data, specifications and certificates where necessary.

1.8 JOB CONDITIONS:

- A. Submittal data shall demonstrate that the proposed material and equipment is in compliance with the design criteria and the requirements of the Contract Documents. Submittals shall provide a record of the materials and equipment incorporated into the project and shall provide information for maintenance and repairs.
- B. Coordinate submittals, including submittals by various trade installers, and review for accuracy, completeness, and compliance with contract requirements and shall indicate its approval thereon as evidence of such coordination and review. Take complete and accurate field measurements for any item which must fit to field conditions. Include these dimensions on the shop drawings, indicating that the measurements represent actual dimensions obtained at the site.
- C. Submittals that do not have Contractor's approval stamp will be returned without processing. Affix an approval stamp to each submittal stating that it has been reviewed and includes any necessary corrections, and the material contained therein is in compliance with the Contract Documents. The stamp shall have the following information:

Name of Project: _____
Contract No. _____
Contractor's Name: _____
Project No. _____ Submittal No. _____
Drawing No. _____ Spec. Ref.: _____

This shop drawing has been reviewed and determined to be in compliance with the Contract Documents, including Plans and Specifications, as modified by Addenda, Change Orders, and Field Orders as of the date of this submittal.

Contractor's Signature: _____ Date: _____

- D. Contractor is responsible to coordinate the submittals between the various trades. When a proposed component requires modification to some other part of the project, the Contractor shall also include the revision or modifications necessary to incorporate the proposed item.

- E. The Resident Engineer will indicate approval or disapproval of the shop drawings, and if not approved as submitted, shall indicate the reasons for disapproval. Work done before such approval shall be at the Contractor's risk. Approval by the Resident Engineer shall not relieve the Contractor from responsibility for any errors or omissions in such submittals, nor from responsibility for complying with the requirements of this contract.

1.9 SCHEDULES:

- A. All submittals, including samples, certificates, test reports, and shop drawings shall be submitted in ample time for the Resident Engineer to make a determination of compliance with the Contract Documents before fabrication and deliver to the site. Make submittals in advance of first need in ample time to allow for Resident Engineer's review (15 calendar days maximum).
- B. After a submission has been approved, substitutions will not be permitted without written approval by the Resident Engineer.
- C. A Schedule of Submittals is included at the end of this Section. This schedule indicates the type of submittals required for each Section. Submit a copy of this schedule with an estimated date indicating when each submittal will be given to Resident Engineer. Identify submittals for long lead items whose submittal is critical to delivery of equipment. Furnish submittals marked with an asterisk (*) to the Resident Engineer, within fifteen (15) calendar days after receipt of award. These submittals shall be approved before NTP will be issued. The remaining submittals shall be furnished to the Resident Engineer, thirty (30) calendar days after NTP, unless specified otherwise in individual Section (ie. Section 01730, "Operation and Maintenance Manuals." The Contractor is responsible for timely submittals.

1.10 SUBMITTAL SCHEDULE

- A. Submittal Schedule Legend:
 - 1. SD - Shop Drawing
 - 2. SAM - Sample
 - 3. CTR - Certified Test Report
 - 4. CLS - Certification of Local Field Services
 - 5. ESA - Extended Service Agreement
 - 6. CAD - Certificate of Adequacy of Design
 - 7. CSQ - Certification of Applicator/Subcontractor Qualifications
 - 8. RD - Record Data
 - 9. OM - Operation and Maintenance Manuals
 - 10. EIR - Equipment Installation Report

SPEC NO.	DESCRIPTION	S D	S A M	C T R	C L S	E S A	C A D	C S Q	R D	O M	E I R
01045	Cutting and Patching	X							X		
01300	Submittals	X									
01400	Quality Control			X					X		
01421	Ref. Standards and Definitions								X		
01600	Materials and Equipment			X					X		
01613	Delivery, Storage, and Handling (FF&E)										
01631	Substitutions								X		
01710	Final Cleaning										
01730	Operation and Maintenance Data								X	X	
01740	Warranties								X	X	
05120	Structural Steel	X		X					X		
08110	Steel Doors and Frames	X		X					X		
08710	Door Hardware	X							X		
09255	Gypsum Board Assemblies								X		
09900	Painting		X						X		
10200	Louvers and Vents	X							X		
15010	Gen. Requirements for Mech. Work										
15050	Basic Mech. Materials & Methods										
15145	Hangers and Supports	X							X		
15891	Metal Ductwork	X							X		

	DESCRIPTION	S D	S A M	C T R	C L S	E S A	C A D	C S Q	R D	O M	E I R
15910	Duct Accessories	X							X		
15932	Air Outlet and Inlets	X							X		
15933	Air Terminals	X							X	X	X
15970	HVAC Controls	X							X	X	
15990	Testing, Adjusting & Balancing			X							
16050	Basic Electrical Materials and Methods								X		
16100	Raceways, Boxes, and Cabinets								X		
16111	Cable Trays								X		
16120	Wires and Cables								X		
16140	Wiring Devices								X		
16190	Supporting Devices	X							X		
16195	Electrical Identification	X	X						X		
16452	Grounding	X		X			X	X	X	X	
16470	Panelboards								X	X	
16515	Interior Lighting	X							X		

END OF SECTION 01300

SECTION 01310 COORDINATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coordination
- B. Meetings

1.2 RELATED SECTIONS

- A. Section 01320 - Construction Schedules and Reports

1.3 REQUEST FOR INFORMATION (RFI) PROCEDURES

- A. RFIs identifying a technical question relating to the design or construction of the project shall be submitted to Resident Engineer for disposition. Use Contractor's RFI Form to be provided at the Pre-Construction Meeting. Attach drawings, sketches, and other clarifying documents along with recommended resolution if known. Resident Engineer will respond and transmit Government's response to the RFI.
- B. Use Contractor's RFI Form. Contractor will provide sample forms at the Pre-construction meeting. Accurately complete the form and submit three (3) copies to the Resident Engineer and one (1) copy to the Contracting Officer.
- C. If Contractor determines that Government's response to the RFI may impose a cost or a schedule impact on the Work, Contractor shall inform the Resident Engineer within (3) working days from receipt. Contractor is not to proceed with any Work that incurs additional cost or time on the basis of an RFI. If no cost or schedule impact notification is received from Contractor within specified time, Contractor will be deemed to have accepted Government's response and responsibility for Work described therein.
- D. Contractor shall be responsible for maintaining its own RFI log. The RFI number shall be prefixed by Government's assigned 3 digits followed by a dash followed by a sequential number starting at 001.

1.4 WEEKLY PROGRESS MEETINGS

- A. Meetings with Contractor shall be held weekly with date, time and location to be specified by Resident Engineer. The purpose of these meetings will be to conduct a joint review, review the quality of the on-going Work, and agree on project progress and subsequent submittals of updated and actual progress schedules. The Contracting Officer will be keeping meeting minutes at the pre-construction meeting.

1.5 Pre-INSTALLATION/Pre-work Meetings

- A. When required in individual specification sections, convene a pre-installation meeting at Worksite before starting Work requiring a written Work plan. The purpose of the meeting will be to review the Contractor's Work plan, determine acceptability of the Contractor's Work plan, and provide authorization to proceed with the Work if the Work plan is acceptable. Require attendance of parties directly affecting, or affected by, Work of the specific section

and Resident Engineer. Notify the Resident Engineer a minimum of two (2) days before the meeting.

1.6 UTILITY OUTAGES

- A. Accomplish all work required in connection with utility outages on weekends or off-duty hours, as approved by the base and as directed by the Resident Engineer. The Contractor shall be responsible for all work associated with the utility outages.
- B. Notify the base in writing 14 days prior to the desired date for the utility outage.

1.7 TRAFFIC REGULATION

- A. Barriers: Contractor shall furnish all signs, barricades, and flagmen required to control traffic in the construction area.
 - 1. All signs and barricades shall be in accordance with ANSI D6.1, Manual of Uniform Traffic Control Devices.
 - 2. Minimize interference with the flow of traffic. At no time may access to any facility be prevented.
- B. Haul routes: As designated by the base, which will be from the project site directly along surface roads and through gate 29B.
 - 1. Immediately clean up any material spilled along the haul route. This shall include clean up of mud tracked on the road by contractor equipment.
 - 2. For any spill of hazardous material on base, immediately notify the base fire department at 911. The Contractor is responsible for all costs incurred by the Government in responding to or cleaning up any such spill.
- C. Access: Contractor shall maintain access to the base work site at all times. The Contractor is to perform his work with a minimum of interference to the flow of base traffic.

PART 2 PRODUCTS [Not Used]

PART 3 EXECUTION [Not Used]

END OF SECTION

SECTION 01320 CONSTRUCTION SCHEDULES AND REPORTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for Scheduling
- B. Monthly Progress Reporting.

1.2 RELATED SECTIONS

- A. General Provisions, Article 3, Performance
- B. Section 01290, Payment Procedures
- C. Section 01330, Submittal Procedure

1.3 GENERAL REQUIREMENTS FOR CONSTRUCTION PROGRESS SCHEDULE

- A. Provide complete sequence of construction of Work in the Schedule. Show order in which Contractor proposes to perform Work with dates on which Contractor contemplates starting and completing the several salient features of the Work. The Schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of Work scheduled for completion by any given date during the period.
- B. Update the Schedule weekly and provide copy to the Resident Engineer. Schedule updates shall be the product of joint review meetings between the Contractor and Resident Engineer. Enter actual progress on Schedule as agreed upon by the Government. If in the opinion of the Government, the Contractor falls behind the approved Schedule, the Contractor shall take steps necessary to improve its progress without additional cost to the Government.
- C. On a monthly basis Contractor shall submit three (3) copies of the updated Schedule. After all Contract Work items are complete, and as a condition of final payment, Contractor shall submit three (3) copies of an "As-built Contract Schedule" in same format as the Schedule showing actual start and finish dates for all Work activities and milestones, based on the accepted monthly updates.

1.4 MONTHLY PROGRESS REPORTING

- A. Monthly Schedule updates shall be the product of joint review meetings between the Contractor, the Resident Engineer, and major active subcontractors. The joint review shall focus on actual progress for the preceding month, planned progress for the upcoming month (supported by a Contractor prepared 4-Week and 2-Week Look-ahead Schedule if required by the Resident Engineer), impact to Schedule due to change notices issued, adverse weather, and any effected changes to the construction Schedule. The agreed upon progress and changes shall be incorporated in the Schedule update to be submitted. The update shall always represent the actual history of accomplishment of all activities.
- B. The monthly Schedule update shall form the basis for the Contractor's progress payments. The progress payment for an activity shall be based on its agreed upon percentage of completion. On unit priced contracts, the approval of the Contractor's monthly requisition is contingent on

the submittal of a satisfactory monthly Schedule update, however, the basis of payment will be the actual measurement of Resident Engineer-accepted in-place units of Work.

PART 2 PRODUCTS [Not Used]

PART 3 EXECUTION [Not Used]

SECTION 01400 - QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality-control services.
- B. Quality-control services include inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by Architect.
- C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
- D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.
 - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- E. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section 01045 "Cutting and Patching" specifies requirements for repair and restoration of construction disturbed by inspection and testing activities.
 - 2. Division 1 Section 01300 "Submittals" specifies requirements for development of a schedule of required tests and inspections.

1.3 RESPONSIBILITIES

- A. Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide inspections, tests, and other quality-control

services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. Costs for these services are included in the Contract Sum.

1. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Contractor's responsibility, the Contractor shall employ and pay a qualified independent testing agency to perform quality-control services. Costs for these services are included in the Contract Sum.
 2. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Owner's responsibility, the Owner will employ and pay a qualified independent testing agency to perform those services.
 3. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Owner's responsibility, the Owner will engage the services of a qualified independent testing agency to perform those services. Payment for these services will be made from the Inspection and Testing Allowance, as authorized by Change Orders.
 - a. Where the Owner has engaged a testing agency for testing and inspecting part of the Work, and the Contractor is also required to engage an entity for the same or related element, the Contractor shall not employ the entity engaged by the Owner, unless agreed to in writing by the Owner.
- B. Retesting: The Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was Contractor's responsibility.
1. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements.
- C. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:
1. Provide access to the Work.
 2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
 3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
 4. Provide facilities for storage and curing of test samples.
 5. Deliver samples to testing laboratories.
 6. Provide the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
 7. Provide security and protection of samples and test equipment at the Project Site.
- D. Duties of the Testing Agency: The independent agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Sections shall cooperate with the Architect and the Contractor in performance of the agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.

1. The agency shall notify the Architect and the Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
 3. The agency shall not perform any duties of the Contractor.
- E. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

1.4 SUBMITTALS

- A. Unless the Contractor is responsible for this service, the independent testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the Architect. If the Contractor is responsible for the service, submit a certified written report, in duplicate, of each inspection, test, or similar service through the Contractor.
1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
 2. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the following:
 - a. Date of issue.
 - b. Project title and number.
 - c. Name, address, and telephone number of testing agency.
 - d. Dates and locations of samples and tests or inspections.
 - e. Names of individuals making the inspection or test.
 - f. Designation of the Work and test method.
 - g. Identification of product and Specification Section.
 - h. Complete inspection or test data.
 - i. Test results and an interpretation of test results.
 - j. Ambient conditions at the time of sample taking and testing.
 - k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
 - l. Name and signature of laboratory inspector.
 - m. Recommendations on retesting.

1.5 QUALITY ASSURANCE

- A. Qualifications for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, that are prequalified as complying with the American Council of Independent Laboratories' "Recommended Requirements for Independent Laboratory Qualification" and that specialize in the types of inspections and tests to be performed.

1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state where the Project is located.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Division 1 Section 01045 "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.
- C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION 01400

SECTION 01421 - REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic contract definitions are included in the Conditions of the Contract.
- B. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on the Drawings; or to other paragraphs or schedules in the Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference. Location is not limited.
- C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the Architect, requested by the Architect, and similar phrases.
- D. "Approved": The term "approved," when used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the Architect's duties and responsibilities as stated in the Conditions of the Contract.
- E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": The term "furnish" means to supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": The term "install" describes operations at the Project site including the actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.
- I. "Installer": An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1. The term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.
 2. Trades: Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.
 3. Assigning Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.
 - a. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade-union jurisdictional settlements and similar conventions.
- J. "Project site" is the space available to the Contractor for performing construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.
- K. "Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

- A. Specification Format: These Specifications are organized into Divisions and Sections based on the 16-division format and CSI/CSC's "MasterFormat" numbering system.
- B. Specification Content: These Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpolated as the sense requires. Singular words shall be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Section Text, subjective language is used

for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others when so noted.

- a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1.4 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of the date of the Contract Documents.
- C. Conflicting Requirements: Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to the Architect for a decision before proceeding.
 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the Architect for a decision before proceeding.
- D. Copies of Standards: Each entity engaged in construction on the Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 1. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source and make them available on request.
- E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where abbreviations and acronyms are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-producing organization, authorities having jurisdiction, or other entity applicable to the context of the text provision. Refer to Gale Research's "Encyclopedia of Associations" or Columbia Books' "National Trade & Professional Associations of the U.S.," which are available in most libraries.
- F. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. The following abbreviations and acronyms, as referenced in the Contract Documents, mean the associated names. Names and addresses are subject to

change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association 900 19th St., NW, Suite 300 Washington, DC 20006 www.aluminum.org	(202) 862-5100
AABC	Associated Air Balance Council 1518 K St., NW, Suite 503 Washington, DC 20005 www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association 1827 Walden Office Sq., Suite 104 Schaumburg, IL 60173-4268 www.aamanet.org	(847) 303-5664
AAN	American Association of Nurserymen (See ANLA)	
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol St., NW, Suite 249 Washington, DC 20001 www.aashto.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists P.O. Box 12215 One Davis Dr. Research Triangle Park, NC 27709-2215 www.aatcc.org	(919) 549-8141
ABMA	American Bearing Manufacturers Association (Formerly: Anti-Friction Bearing Manufacturers Association) 1200 19th St., NW, Suite 300 Washington, DC 20036-2401 www.abma-dc.org	(202) 429-5155
ABMA	American Boiler Manufacturers Association 950 North Glebe Rd., Suite 160 Arlington, VA 22203-1824 www.abma.com	(703) 522-7350

ACI	American Concrete Institute P.O. Box 9094 Farmington Hills, MI 48333-9094 www.aci-int.org	(248) 848-3700
ACIL	ACIL: The Association of Independent Scientific, Engineering, and Testing Firms 1629 K St., NW, Suite 400 Washington, DC 20006 www.acil.org	(202) 887-5872
ACPA	American Concrete Pipe Association 222 West Las Colinas Blvd., Suite 641 Irving, TX 75039-5423 www.concrete-pipe.org	(972) 506-7216
ADC	Air Diffusion Council 11 South LaSalle St., Suite 1400 Chicago, IL 60603	(312) 201-0101
AEIC	Association of Edison Illuminating Companies 600 N. 18th St. P.O. Box 2641 Birmingham, AL 35291-0992	(205) 250-2530
AFBMA	Anti-Friction Bearing Manufacturers Association (See ABMA)	
AFPA	American Forest and Paper Association (Formerly: National Forest Products Association) 1111 19th St., NW, Suite 800 Washington, DC 20036	(800) 878-8878 (202) 463-2700
AGA	American Gas Association 1515 Wilson Blvd. Arlington, VA 22209 www.aga.com	(703) 841-8400
AHA	American Hardboard Association 1210 W. Northwest Hwy Palatine, IL 60067-1897	(847) 934-8800

AHAM	Association of Home Appliance Manufacturers 20 N. Wacker Dr., Suite 1500 Chicago, IL 60606 www.aham.org	(312) 984-5800
AI	Asphalt Institute Research Park Dr. P.O. Box 14052 Lexington, KY 40512-4052 www.asphaltinstitute.org	(606) 288-4960
AIA	The American Institute of Architects 1735 New York Ave., NW Washington, DC 20006-5292 www.aia.org	(202) 626-7300
AIA	American Insurance Association 1130 Connecticut Ave., NW, Suite 1000 Washington, DC 20036	(202) 828-7100
AIHA	American Industrial Hygiene Association 2700 Prosperity Ave., Suite 250 Fairfax, VA 22031	(703) 849-888
AISC	American Institute of Steel Construction One East Wacker Dr., Suite 3100 Chicago, IL 60601-2001	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute 1101 17th St., NW Washington, DC 20036-4700 www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction 7012 S. Revere Pkwy, Suite 140 Englewood, CO 80112 www.aitc-glulam.org	(303) 792-9559
ALA	American Laminators Association (See LMA)	
ALCA	Associated Landscape Contractors of America 12200 Sunrise Valley Dr., Suite 150 Reston, VA 20191 www.alca.org	(703) 620-6363

ALI	Associated Laboratories, Inc. P.O. Box 152837 1323 Wall St. Dallas, TX 75315	(214) 565-0593
ALSC	American Lumber Standards Committee P.O. Box 210 Germantown, MD 20875	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. 30 W. University Dr. Arlington Heights, IL 60004-1893 www.amca.org	(847) 394-0150
ANLA	American Nursery and Landscape Association (Formerly: American Association of Nurserymen) 1250 Eye St., NW, Suite 500 Washington, DC 20005	(202) 789-2900
ANSI	American National Standards Institute 11 West 42nd St., 13th Floor New York, NY 10036-8002 www.ansi.org	(212) 642-4900
AOAC	AOAC International 481 N. Frederick Ave., Suite 500 Gaithersburg, MD 20877	(301) 924-7077
AOSA	Association of Official Seed Analysts 201 N. 8th St., Suite 400 P.O. Box 81152 Lincoln, NE 68501-1152	(402) 476-3852
APA	APA-The Engineered Wood Association (Formerly: American Plywood Association) P.O. Box 11700 Tacoma, WA 98411-0700 www.apawood.org	(206) 565-6600
APA	Architectural Precast Association P.O. Box 08669 Fort Myers, FL 33908-0669	(941) 454-6989

API	American Petroleum Institute 1220 L St., NW, Suite 900 Washington, DC 20005-8029	(202) 682-8000
ARI	Air-Conditioning and Refrigeration Institute 4301 Fairfax Dr., Suite 425 Arlington, VA 22203 www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association Center Park 4041 Powder Mill Rd., Suite 404 Calverton, MD 20705	(301) 231-9050
ASA	Acoustical Society of America 500 Sunnyside Blvd. Woodbury, NY 11797	(516) 576-2360
ASC	Adhesive and Sealant Council 1627 K St., NW, Suite 1000 Washington, DC 20006-1707	(202) 452-1500
ASCA	Architectural Spray Coaters Association 230 W. Wells St., Suite 311 Milwaukee, WI 53203	(414) 273-3430
ASCE	American Society of Civil Engineers-World Headquarters 1801 Alexander Bell Dr. Reston, VA 20191-4400 www.asce.org	(800) 548-2723 (703) 295-6000
ASHES	American Society for Healthcare Environmental Services - Division of the American Hospital Assoc. One North Franklin, Suite 2700 Chicago, IL 60606	(800) 424-2626 (312) 422-3860
ASHRAE	American Society of Heating, Refrigerating and Air- Conditioning Engineers 1791 Tullie Circle, NE Atlanta, GA 30329-2305 www.ashrae.org	(800) 527-4723 (404) 636-8400

ASLA	American Society of Landscape Architects 4401 Connecticut Ave., NW, 5th Floor Washington, DC 20008-2369 www.asla.org	(202) 686-2752
ASME	American Society of Mechanical Engineers 345 East 47th St. New York, NY 10017-2392 www.asme.org	(800) 434-2763 (212) 705-7722
ASPA	American Sod Producers Association (See TPI)	
ASPE	American Society of Plumbing Engineers 3617 Thousand Oaks Blvd., Suite 210 Westlake Village, CA 91362-3649	(805) 495-7120
ASQC	American Society for Quality Control 611 East Wisconsin, Ave. Milwaukee, WI 53201-3005 www.asqc.org	(800) 248-1946 (414) 272-8575
ASSE	American Society of Sanitary Engineering 28901 Clemens Rd. Westlake, OH 44145 www.asse-plumbing.org	(216) 835-3040
ASTM	American Society for Testing and Materials 100 Barr Harbor Dr. West Conshohocken, PA 19428-2959 www.astm.org	(610) 832-9500
ATIS	Alliance for Telecommunications Industry Solutions (Formerly: Exchange Carriers Standards Association) 1200 G St., NW, Suite 500 Washington, DC 20005	(202) 628-6380
AWCI	Association of the Wall and Ceiling Industries— International 307 E. Annandale Rd., Suite 200 Falls Church, VA 22042-2433 www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (See WCMA)	

AWI	Architectural Woodwork Institute 1952 Isaac Newton Sq. Reston, VA 20190 www.awinet.org	(703) 733-0600
AWPA	American Wood Preservers' Association 3246 Fall Creek Hwy, Suite 1900 Granbury, TX 76049-7979	(817) 326-6300
AWPB	American Wood Preservers' Bureau (This organization is now defunct.)	
AWS	American Welding Society 550 NW LeJeune Rd. Miami, FL 33126 www.amweld.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association 6666 W. Quincy Ave. Denver, CO 80235 www.awwa.org	(800) 926-7337 (303) 794-7711
BANC	Brick Association of North Carolina P.O. Box 13290 Greensboro, NC 27415-3290	(800) 622-7425 (910) 273-5566
BHMA	Builders Hardware Manufacturers Association 355 Lexington Ave., 17th Floor New York, NY 10017-6603	(212) 661-4261
BIA	Brick Institute of America 11490 Commerce Park Dr. Reston, VA 22091-1525 www.bia.org	(703) 620-0010
BIFMA	The Business and Institutional Furniture Manufac- turer's Association 2680 Horizon Dr., SE, Suite A1 Grand Rapids, MI 49546-7500 www.bifma.com	(616) 285-3963
CAGI	Compressed Air and Gas Institute c/o Thomas Associates, Inc.	(216) 241-7333

1300 Sumner Ave.
Cleveland, OH 44115-2851
www.taol.com/cagi

CAUS	Color Association of the United States 409 W. 44th St. New York, NY 10036-4402	(212) 582-6884
CBM	Certified Ballast Manufacturers Association 1422 Euclid Ave., Suite 402 Cleveland, OH 44115-2094	(216) 241-0711
CCC	Carpet Cushion Council P.O. Box 546 Riverside, CT 06878-0546	(203) 637-1312
CDA	Copper Development Association Inc. 260 Madison Ave., 16th Floor New York, NY 10016-2401 www.copper.org	(800) 232-3282 (212) 251-7200
CFFA	Chemical Fabrics & Film Association, Inc. c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/cffa	(216) 241-7333
CGA	Compressed Gas Association 1725 Jefferson Davis Hwy, Suite 1004 Arlington, VA 22202-4102 www.cganet.com	(703) 412-0900
CGSB	Canadian General Standards Board Place du Portage Phase III, 6B1 11 Laurier St. Hull, Quebec K1A 1G6 CANADA www.pwgsc.gc.ca/cgsb Mailing Address: Canadian General Standards Board Sales Centre Ottawa K1A 1G5 CANADA	(819) 956-3500 (800) 665-2472 (819) 956-0425

CISCA	Ceilings and Interior Systems Construction Association 1500 Lincoln Hwy, Suite 202 St. Charles, IL 60174 www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute 5959 Shallowford Rd., Suite 419 Chattanooga, TN 37421	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute 9891 Broken Land Pkwy, Suite 300 Columbia, MD 21046	(301) 596-2584
CPPA	Corrugated Polyethylene Pipe Association 432 N. Superior St. Toledo, OH 43604	(800) 510-2772 (419) 241-2221
CRI	Carpet and Rug Institute 310 S. Holiday, Ave. Dalton, GA 30722-2048 www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute 933 N. Plum Grove Rd. Schaumburg, IL 60173-4758 www.crsi.org	(847) 517-1200
CSSB	Cedar Shake and Shingle Bureau 515 116th Ave., NE, Suite 275 Bellevue, WA 98004-5294	(206) 453-1323
CTI	Ceramic Tile Institute of America 12061 West Jefferson Blvd. Culver City, CA 90230-6219	(310) 574-7800
CTI	Cooling Tower Institute P.O. Box 73383 Houston, TX 77273	(281) 583-4087
DASMA	Door and Access Systems Manufacturers Association, International (Formerly: National Association of Garage Door Manufacturers) c/o Thomas Associates, Inc. 1300 Sumner Ave.	(216) 241-7333

	Cleveland, OH 44115-2851 www.taol.com/dasma	
DHI	Door and Hardware Institute (Formerly: National Builders Hardware Association) 14170 Newbrook Dr. Chantilly, VA 20151-2223 www.dhi.org	(703) 222-2010
DIPRA	Ductile Iron Pipe Research Association 245 Riverchase Pkwy East, Suite O Birmingham, AL 35244	(205) 988-9870
DLPA	Decorative Laminate Products Association (Dissolved in 1995 - Now part of KCMA.)	
ECSA	Exchange Carriers Standards Association (See ATIS)	
EIA	Electronic Industries Association 2500 Wilson Blvd. Arlington, VA 22201	(703) 907-7500
EIMA	EIFS Industry Members Association 402 N. Fourth St., Suite 102 Yakima, WA 98901-2470 www.eifsfacts.com	(800) 294-3462 (509) 457-3500
EJMA	Expansion Joint Manufacturers Association 25 N. Broadway Tarrytown, NY 10591-3201	(914) 332-0040
ETL	ETL Testing Laboratories, Inc. (Now part of ITS)	
FCI	Fluid Controls Institute c/o Thomas Associates, Inc 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/fci	(216) 241-7333
FCICA	Floor Covering Installation Contractors Association (Formerly: Floor Covering Installation Board) P.O. Box 948 Dalton, GA 30722-0948	(706) 226-5488

FGMA	Flat Glass Marketing Association (See GANA)	
FM	Factory Mutual System 1151 Boston-Providence Tnpk. P.O. Box 9102 Norwood, MA 02062-9102 www.factorymutual.com	(781) 762-4300
FTI	Facing Tile Institute c/o Stark Ceramics P.O. Box 8880 Canton, OH 44711	(330) 488-1211
GA	Gypsum Association 810 First St., NE, Suite 510 Washington, DC 20002 www.usg.com	(202) 289-5440
GANNA	Glass Association of North America (Formerly: Flat Glass Marketing Association) 3310 SW Harrison St. Topeka, KS 66611-2279 www.glasswebsite.com/ganna	(913) 266-7013
GRI	Geosynthetic Research Institute 33rd and Lancaster Walk Rush Building, West Wing Philadelphia, PA 19104 www.gri-server.coe.drexel.edu	(215) 895-2343
HEI	Heat Exchange Institute c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/hei	(216) 241-7333
HI	Hydraulic Institute 9 Sylvan Way Parsippany, NJ 07054-3802	(201) 267-9700
HI	Hydronics Institute Division of Gas Appliance Manufacturers Association P.O. Box 218 35 Russo Pl.	(908) 464-8200

	Berkeley Heights, NJ 07922 www.gamanet.org	
HMA	Hardwood Manufacturers Association (Formerly: Southern Hardwood Lumber Manufacturers Association) 400 Penn Center Blvd., Suite 530 Pittsburgh, PA 15235-5605 www.hardwood.org	(412) 829-0770
HPVA	Hardwood Plywood and Veneer Association 1825 Michael Farraday Dr. P.O. Box 2789 Reston, VA 22195-0789 www.hpva.org	(703) 435-2900
IAS	International Approval Services 8504 East Pleasant Valley Rd. Cleveland, OH 44131 www.iasapprovals.org	(216) 524-4990
IBD	Institute of Business Designers (Now part of IIDA)	
ICEA	Insulated Cable Engineers Association, Inc. P.O. Box 440 South Yarmouth, MA 02664	(508) 394-4424
IEC	International Electrotechnical Commission (Available from ANSI) 11 West 42nd St., 13th Floor New York, NY 10036-8002	(212) 642-4900
IEEE	Institute of Electrical and Electronics Engineers 345 E. 47th St. New York, NY 10017-2394 www.ieee.org	(800) 678-4333 (212) 705-7900
IESNA	Illuminating Engineering Society of North America 120 Wall St., 17th Floor New York, NY 10005-4001 www.iesna.org	(212) 248-5000
IGCC	Insulating Glass Certification Council (Now part of ITS)	

IIDA	International Interior Design Association 341 Merchandise Mart Chicago, IL 60654-1104	(312) 467-1950
ILI	Indiana Limestone Institute of America Stone City Bank Building, Suite 400 Bedford, IN 47421	(812) 275-4426
IMSA	International Municipal Signal Association P.O. Box 539 165 E. Union St. Newark, NY 14513	(800) 723-4672 (315) 331-2182
INCE	Institute of Noise Control Engineering P.O. Box 3206, Arlington Branch Poughkeepsie, NY 12603	(914) 462-4006
IRI	Industrial Risk Insurers P.O. Box 5010 85 Woodland St. Hartford, CT 06102-5010	(860) 520-7300
ISA	ISA - International Society for Measurement and Control P.O. Box 12277 67 Alexander Dr. Research Triangle Park, NC 27709 Www.isa.org	(919) 549-8411
ISS	Iron and Steel Society 410 Commonwealth Dr. Warrendale, PA 15086-7512 www.issource.org	(412) 776-1535
ISWA	Insect Screening Weavers Association P.O. Box 1018 Ossining, NY 10562	(914) 962-9052
ITS	Intertek Testing Services (Formerly: Inchcape Testing Services) P.O. Box 2040 3933 US Route 11 Cortland, NY 13045-7902	(800) 345-3851 (607) 753-6711

	www.itsglobal.com	
KCMA	Kitchen Cabinet Manufacturers Association (Formerly: National Kitchen Cabinet Association) 1899 Preston White Dr. Reston, VA 22091-4326 www.kema.org	(703) 264-1690
LGSI	Light Gage Structural Institute c/o Loseke Technologies, Inc. P.O. Box 560746 The Colony, TX 75056	(972) 625-4560
LIA	Lead Industries Association, Inc. 295 Madison Ave. New York, NY 10017 www.leadinfo.com	(800) 422-5323 (212) 578-4750
LMA	Laminating Materials Association (Formerly: American Laminators Association) 116 Lawrence St. Hillsdale, NJ 07642-2730 www.lma.org	(201) 664-2700
LPI	Lightning Protection Institute 3335 N. Arlington Heights Rd., Suite E Arlington Heights, IL 60004-7700	(800) 488-6864 (847) 577-7200
MBMA	Metal Building Manufacturer's Association c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/mbma	(216) 241-7333
MCAA	Mechanical Contractors Association of America 1385 Piccard Dr. Rockville, MD 20850-4329	(301) 869-5800
MFMA	Maple Flooring Manufacturers Association 60 Revere Dr., Suite 500 Northbrook, IL 60062 www.maplefloor.com	(847) 480-9138
MFMA	Metal Framing Manufacturers Association (Formerly: Wood and Synthetic Flooring Institute) 401 N. Michigan Ave.	(312) 644-6610

Chicago, IL 60611

MHI	Material Handling Institute (A Division of the Material Handling Industry) 8720 Red Oak Blvd., Suite 201 Charlotte, NC 28217-3992 www.mhi.org	(800) 345-1815 (704) 522-8644
MIA	Marble Institute of America 30 Eden Alley, Suite 301 Columbus, OH 43215 www.marble-institute.com	(614) 228-6194
MIA	Masonry Institute of America 2550 Beverly Blvd. Los Angeles, CA 90057 www.masonryinstitute.org	(213) 388-0472
ML/SFA	Metal Lath/Steel Framing Association (A Division of the NAAMM) 8 South Michigan Ave., Suite 1000 Chicago, IL 60603	(312) 456-5590
MRCA	Midwest Roofing Contractors Association 4840 W. 15th St., Suite 1000 Lawrence, KS 66049	(800) 879-4448 (913) 843-4888
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry 127 Park St., NE Vienna, VA 22180-4602	(703) 281-6613
NAA	National Arborist Association P.O. Box 1094 Amherst, NH 03031-1094 www.natlarb.com	(800) 733-2622 (603) 673-3311
NAAMM	National Association of Architectural Metal Manufac- turers 8 South Michigan Ave., Suite 1000 Chicago, IL 60603 www.gss.net/naamm	(312) 456-5590
NAGDM	National Association of Garage Door Manufacturers (See DASMA)	

NAIMA	North American Insulation Manufacturers Association (Formerly: Thermal Insulation Manufacturers Association) 44 Canal Center Plaza, Suite 310 Alexandria, VA 22314 www.naima.org	(703) 684-0084
NAMI	National Accreditation & Management Institute, Inc. P.O. Box 366 207 S. Washington St. Berkeley Springs, WV 25411	(304) 258-5100
NAPA	National Asphalt Pavement Association NAPA Building 5100 Forbes Blvd. Lanham, MD 20706-4413	(301) 731-4748
NAPM	National Association of Photographic Manufacturers 550 Mamaroneck Ave. Harrison, NY 10528	(914) 698-7603
NBHA	National Builders Hardware Association (See DHI)	
NCAC	National Council of Acoustical Consultants P.O. Box 359 66 Morris Ave., Suite 1A Springfield, NJ 07081	(201) 564-5859
NCCA	National Coil Coaters Association 401 N. Michigan Ave. Chicago, IL 60611	(312) 321-6894
NCMA	National Concrete Masonry Association 2302 Horse Pen Rd. Herndon, VA 20171-3499 www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute P.O. Box 759 253-80 Center St. Lake Geneva, WI 53147	(414) 248-9094

NCRPM	National Council on Radiation Protection and Measurements 7910 Woodmont Ave., Suite 800 Bethesda, MD 20814-3095 www.ncrp.com	(800) 229-2652 (301) 657-2652
NCSPA	National Corrugated Steel Pipe Association 1255 23rd St., NW, Suite 850 Washington, DC 20037 www.ncspa.org	(202) 452-1700
NEBB	Natural Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877-4121	(301) 977-3698
NECA	National Electrical Contractors Association 3 Bethesda Metro Center, Suite 1100 Bethesda, MD 20814-5372	(301) 657-3110
NEI	National Elevator Industry 185 Bridge Plaza North, Suite 310 Fort Lee, NJ 07024	(201) 944-3211
NELMA	Northeastern Lumber Manufacturers Association 272 Tuttle Rd. P.O. Box 87A Cumberland Center, ME 04021	(207) 829-6901
NEMA	National Electrical Manufacturers Association 1300 N 17th St., Suite 1847 Rosslyn, VA 22209 www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association P.O. Box 687 106 Stone St. Morrison, CO 80465-1526 www.electricnet.com/neta	(303) 697-8441
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101 www.nfpa.org	(800) 344-3555 (617) 770-3000

NFPA	National Forest Products Association (See AFPA)	
NFRC	National Fenestration Rating Council Incorporated 1300 Spring St., Suite 120 Silver Spring, MD 20910 www.nfrc.org	(301) 589-NFRC
NHLA	National Hardwood Lumber Association P.O. Box 34518 Memphis, TN 38184-0518 www.natlhardwood.org	(901) 377-1818
NIA	National Insulation Association (Formerly: National Insulation and Abatement Contractors Association) 99 Canal Center Plaza, Suite 222 Alexandria, VA 22314 www.insulation.org	(703) 683-6422
NIAC	National Insulation and Abatement Contractors Association (See NIA)	
NKCA	National Kitchen Cabinet Association (See KCMA)	
NLGA	National Lumber Grades Authority #406-First Capital Pl., 960 Quayside Dr. New Westminster, BC V3M 6G2	(604) 524-2393
NOFMA	National Oak Flooring Manufacturers Association P.O. Box 3009 Memphis, TN 38173-0009	(901) 526-5016
NPA	National Particleboard Association 18928 Premiere Ct. Gaithersburg, MD 20879-1569 www.pbmdf.com	(301) 670-0604
NPCA	National Paint and Coatings Association 1500 Rhode Island Ave., NW Washington, DC 20005-5597 www.paint.org	(202) 462-6272

NRCA	National Roofing Contractors Association O'Hare International Center 10255 W. Higgins Rd., Suite 600 Rosemont, IL 60018-5607 www.roofonline.org	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association 900 Spring St. Silver Spring, MD 20910 www.nrmca.org	(301) 587-1400
NSA	National Stone Association 1415 Elliot Pl., NW Washington, DC 20007 www.aggregates.org	(202) 342-1100
NSF	NSF International (Formerly: National Sanitation Foundation) P.O. Box 130140 Ann Arbor, MI 48113-0140 www.nsf.org	(313) 769-8010
NSSEA	National School Supply and Equipment Association 8300 Colesville Rd., Suite 250 Silver Spring, MD 20910	(800) 395-5550 (301) 495-0240
NTMA	National Terrazzo and Mosaic Association 3166 Des Plaines Ave., Suite 121 Des Plaines, IL 60018 www.ntma.com	(800) 323-9736 (847) 635-7744
NUSIG	National Uniform Seismic Installation Guidelines 12 Lahoma Ct. Alamo, CA 94526	(510) 946-0135
NWMA	National Woodwork Manufacturers Association (See NWWDA)	

NWWDA	National Wood Window and Door Association (Formerly: National Woodwork Manufacturers Association) 1400 E. Touhy Ave., G-54 Des Plaines, IL 60018 www.nwwda.org	(800) 223-2301 (847) 299-5200
PATMI	Power Actuated Tool Manufacturers' Institute, Inc. 1603 Boonslick Rd. St. Charles, MO 63301-2244	(314) 947-6610
PCA	Portland Cement Association 5420 Old Orchard Rd. Skokie, IL 60077-1083 www.portcement.org	(847) 966-6200
PCI	Precast/Prestressed Concrete Institute 175 W. Jackson Blvd. Chicago, IL 60604 www.pci.org	(312) 786-0300
PDCA	Painting and Decorating Contractors of America 3913 Old Lee Hwy, Suite 33-B Fairfax, VA 22030 www.pdca.com	(800) 332-7322 (703) 359-0826
PDI	Plumbing and Drainage Institute 45 Bristol Dr., Suite 101 South Easton, MA 02375	(800) 589-8956 (508) 230-3516
PEI	Porcelain Enamel Institute 4004 Hillsboro Pike, Suite 224-B Nashville, TN 37215 www.porcelainenamel.com	(615) 385-5357
PGI	PVC Geomembrane Institute P.O. Box 4226 Traverse City, MI 49685 users.aol.com/forPVC1	(616) 933-6373
PPFA	Plastic Pipe and Fittings Association 800 Roosevelt Rd., Building C, Suite 20 Glen Ellyn, IL 60137-5833	(630) 858-6540

PPI	Plastic Pipe Institute (The Society of the Plastics Industry, Inc.) 1801 K St., NW, Suite 600L Washington, DC 20006 www.plasticpipe.org	(202) 974-5306
RCMA	Roof Coatings Manufacturers Association Center Park 4041 Powder Mill Rd., Suite 404 Calverton, MD 20705	(301) 230-2501
RCSC	Research Council on Structural Connections Sargent & Lundy 55 E. Monroe St. Chicago, IL 60603	(312) 269-2424
RFCI	Resilient Floor Covering Institute 966 Hungerford Dr., Suite 12-B Rockville, MD 20850-1714	(301) 340-8580
RMA	Rubber Manufacturers Association 1400 K St., NW, Suite 900 Washington, DC 20005 www.rma.org	(800) 220-7620 (202) 682-4800
SAE	SAE International 400 Commonwealth Dr. Warrendale, PA 15096-0001 For publications: Call (412) 776-4970	(412) 776-4841
SDI	Steel Deck Institute P.O. Box 25 Fox River Grove, IL 60021 www.sdi.org	(847) 462-1930
SDI	Steel Door Institute 30200 Detroit Rd. Cleveland, OH 44145-1967	(216) 889-0010
SEFA	Scientific Equipment and Furniture Association 1028 Duchess Dr. McLean, VA 22102-2010 www.sefalabfurn.com	(703) 790-8661
SEGD	Society for Environmental Graphic Design 401 F St., NW, Suite 333	(202) 638-5555

	Washington, DC 20001-2728	
SGCC	Safety Glazing Certification Council (Now part of ITS)	
SHLMA	Southern Hardwood Lumber Manufacturers Association (See HMA)	
SIGMA	Sealed Insulating Glass Manufacturers Association 401 N. Michigan Ave. Chicago, IL 60611-4267	(312) 644-6610
SJI	Steel Joist Institute 3127 10th Ave., North Ext. Myrtle Beach, SC 29577-6760	(803) 626-1995
SMA	Screen Manufacturers Association 2850 S. Ocean Blvd., Suite 114 Palm Beach, FL 33480-5535	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association, Inc. 4201 Lafayette Center Dr. P.O. Box 221230 Chantilly, VA 20151-1209 www.smacna.org	(703) 803-2980
SPI	Society of the Plastics Industry, Inc. Spray Polyurethane Division 1801 K St., NW, Suite 600K Washington, DC 20006 www.socplas.org	(800) 951-2001 (202) 974-5200
SPIB	Southern Pine Inspection Bureau 4709 Scenic Hwy Pensacola, FL 32504-9094	(904) 434-2611
SPRI	SPRI (Formerly: Single Ply Roofing Institute) 175 Highland Ave. Needham Heights, MA 02194-3034	(617) 444-0242
SSINA	Specialty Steel Industry of North America c/o Collier, Shannon Rill & Scott	(800) 982-0355 (202) 342-8630

3050 K St., NW, Suite 400
 Washington, DC 20007
www.ssina.com

SSPC	Steel Structures Painting Council 40 24th St., 6th Floor Pittsburgh, PA 15222-4643	(412) 281-2331
SSPMA	Sump and Sewage Pump Manufacturers Association P.O. Box 647 Northbrook, IL 60065-0647	(847) 559-9233
STI	Steel Tank Institute 570 Oakwood Rd. Lake Zurich, IL 60047-1559	(847) 438-8265
SWI	Steel Window Institute c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/swi	(216) 241-7333
SWPA	Submersible Wastewater Pump Association 1806 Johns Dr. Glenview, IL 60025-1657	(847) 729-7972
SWRI	Sealant, Waterproofing and Restoration Institute 2841 Main Kansas City, MO 64108	(816) 472-7974
TCA	Tile Council of America 100 Clemson Research Blvd. Anderson, SC 29625	(864) 646-8453
TIMA	Thermal Insulation Manufacturers Association (See NAIMA)	
TPI	Truss Plate Institute (Formerly: American Sod Producers Association) 583 D'Onofrio Dr., Suite 200 Madison, WI 53719	(608) 833-5900
TPI	Turfgrass Producers International (Formerly: American Sod Producers Association) 1855-A Hicks Rd. Rolling Meadows, IL 60008	(800) 405-8873 (847) 705-9898

UL	Underwriters Laboratories Inc. 333 Pfingsten Rd. Northbrook, IL 60062 www.ul.com	(800) 704-4050 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association 2655 Villa Creek Dr., Suite 155 Dallas, TX 75234 www.members.aol.com/unibell1	(972) 243-3902
USITT	USITT: The American Association of Design and Production Professionals in the Performing Arts 6443 Ridings Rd. Syracuse, NY 13206-1111	(800) 938-7488 (315) 463-6463
USP	U.S. Pharmacopeia (Formerly: U.S. Pharmacopoeial Convention) 12601 Twinbrook Pkwy Rockville, MD 20852-1790	(800) 227-8772 (301) 881-0666
WA	Wallcoverings Association 401 N. Michigan Ave. Chicago, IL 60611-4267	(312) 644-6610
WCLIB	West Coast Lumber Inspection Bureau P.O. Box 23145 Portland, OR 97281-3145	(503) 639-0651
WCMA	Window Covering Manufacturers Association (Formerly: American Window Covering Manufactur- ers Association) 355 Lexington Ave., 17th Floor New York, NY 10017-6603	(212) 661-4261
WEF	Water Environment Federation (Formerly: Water Pollution Control Federation) 601 Wythe St. Alexandria, VA 22314-1994	(703) 684-2400
WIC	Woodwork Institute of California P.O. Box 980247 West Sacramento, CA 95798-0247	(916) 372-9943

WMMPA	Wood Moulding & Millwork Producers Association 507 First St. Woodland, CA 95695 www.wmmpa.com	(800) 550-7889 (916) 661-9591
WPCF	Water Pollution Control Federation (See WEF)	
WRI	Wire Reinforcement Institute 203 Loudoun St., SW Leesburg, VA 20175-2718	(703) 779-2339
WSC	Water Systems Council Building C, Suite 20 800 Roosevelt Rd. Glen Ellyn, IL 60137	(630) 545-1762
WSFI	Wood and Synthetic Flooring Institute (See MFMA)	
WWPA	Western Wood Products Association Yeon Building 522 SW 5th Ave. Portland, OR 97204-2122	(503) 224-3930

- G. Federal Government Agencies: Names and titles of Federal Government standards- or specification-producing agencies are often abbreviated. The following abbreviations and acronyms referenced in the Contract Documents indicate names of standards- or specification-producing agencies of the Federal Government. Names and addresses are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.

CE	Corps of Engineers (U.S. Department of the Army) 20 Massachusetts Ave., NW Washington, DC 20314 CRD standards are available from: U.S. Army Corps of Engineers Waterways Experiment Station Technical Report Distribution Section Services Branch, TIC 3909 Halls Ferry Rd. Vicksburg, MS 39180-6199	(202) 761-0660 (601) 634-2696
CFR	Code of Federal Regulations (Available from the Government Printing Office)	(202) 512-0000

Washington, DC 20401
(Material is usually published first in the "Federal Register.")
www.access.gpo.gov

CPSC	Consumer Product Safety Commission East West Towers 4330 East-West Hwy Bethesda, MD 20814	(800) 638-2772
CS	Commercial Standard (U.S. Department of Commerce) Government Printing Office Washington, DC 20402 For Commercial standards, contact: Ms. Brenda Umberger CS & PS Specialist c/o NIST Gaithersburg, MD 20899	(202) 512-1800 (301) 975-4036
DOC	Department of Commerce 14th St. and Constitution Ave., NW Washington, DC 20230	(202) 482-2000
DOT	Department of Transportation 400 Seventh St., SW Washington, DC 20590	(202) 366-4000
EPA	Environmental Protection Agency 401 M St., SW Washington, DC 20460	(202) 260-2090
FAA	Federal Aviation Administration (U.S. Department of Transportation) 800 Independence Ave., SW Washington, DC 20591	(202) 366-4000
FCC	Federal Communications Commission 1919 M St., NW Washington, DC 20554	(202) 418-0126
FDA	Food and Drug Administration 5600 Fishers Lane Rockville, MD 20857	(301) 443-1544
FHA	Federal Housing Administration	(202) 401-0388

(U.S. Department of Housing and Urban Development)
451 Seventh St., SW
Washington, DC 20410

FS Federal Specification Unit (202) 619-8925
(Available from GSA)
470 East L'Enfant Plaza, SW, Suite 8100
Washington, DC 20407

GSA General Services Administration (202) 708-5082
F St. and 18th St., NW
Washington, DC 20405

MIL Military Standardization Documents (215) 697-2179
(U.S. Department of Defense)
Defense Printing Service
700 Robbins Ave., Building 4D
Philadelphia, PA 19111

NIST National Institute of Standards and Technology (301) 975-2000
(U.S. Department of Commerce)
Building 101, #A1134,
Rte. I-270 and Quince Orchard Rd.
Gaithersburg, MD 20899

OSHA Occupational Safety and Health Administration (202) 219-8148
(U.S. Department of Labor)
200 Constitution Ave., NW
Washington, DC 20210

PS Product Standard of NBS (202) 512-1800
(U.S. Department of Commerce)
Government Printing Office
Washington, DC 20402
For Product standards, contact:
Ms. Brenda Umberger (301) 975-4036
CS & PS Specialist
c/o NIST
Gaithersburg, MD 20899

RUS Rural Utilities Service (202) 720-9560
(Formerly: Rural Electrification Administration)
(U.S. Department of Agriculture)
14th St. and Independence Ave., SW
Washington, DC 20250

TRB	Transportation Research Board, National Research Council 2101 Constitution Ave., NW Washington, DC 20418	(202) 334-2934
USDA	U.S. Department of Agriculture 14th St. and Independence Ave., SW Washington, DC 20250	(202) 720-8732
USPS	U.S. Postal Service 475 L'Enfant Plaza, SW Washington, DC 20260-0010	(202) 268-2000

1.5 GOVERNING REGULATIONS AND AUTHORITIES

- A. Copies of Regulations: Obtain copies of the following regulations and retain at the Project site to be available for reference by parties who have a reasonable need:

1.6 SUBMITTALS

- A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

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SECTION 01500 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.
- B. Temporary utilities include, but are not limited to, the following:
 - 1. Ventilation.
 - 2. Electric power service.
 - 3. Lighting.
 - 4. Telephone service.
- C. Support facilities include, but are not limited to, the following:
 - 1. Field offices.
 - 2. Storage and fabrication sheds.
 - 3. Lifts and hoists.
 - 4. Construction aids and miscellaneous services and facilities.
- D. Security and protection facilities include, but are not limited to, the following:
 - 1. Environmental protection.
 - 2. Barricades, warning signs, and lights.
 - 3. Temporary enclosures.
 - 4. Temporary partitions.
 - 5. Fire protection.
- E. Related Sections include the following:
 - 1. Division 1 Section 01300 "Submittals" for procedures for submitting copies of implementation and termination schedule and utility reports.
 - 2. Divisions 5 through 16 for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

- A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
 - 1. Owner's construction forces.
 - 2. Occupants of Project.
 - 3. Architect.
 - 4. Testing agencies.
 - 5. Personnel of authorities having jurisdiction.
- B. Water Service: Use water from Owner's existing water system without metering and without payment of use charges.
- C. Electric Power Service: Use electric power from Owner's existing system without metering and without payment of use charges.

1.5 SUBMITTALS

- A. Implementation and Termination Schedule: Within 15 days of date established for submittal of Contractor's Construction Schedule, submit a schedule indicating implementation and termination of each temporary utility.

1.6 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
 - 1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
 - 2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.7 PROJECT CONDITIONS

- A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.
 - 1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
- B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:

1. Keep temporary services and facilities clean and neat.
2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Gypsum Board: Minimum **1/2 inch** thick by **48 inches** wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36.
- C. Paint: Comply with requirements in Division 9 Section 09900 "Painting."
- D. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.
- E. Water: Potable.

2.2 EQUIPMENT

- A. General: Provide equipment suitable for use intended.
- B. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- C. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- D. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- B. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.
- C. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
 - 1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
 - 2. Provide warning signs at power outlets other than 110 to 120 V.
 - 3. Provide 4-gang outlets, spaced so 100-foot extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.
- D. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- E. Telephone Service: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities. Install separate telephone line for each field office and first-aid station.
 - 1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
 - 2. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.

3. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.
- C. Janitorial Services: Provide janitorial services on a daily basis for temporary offices, first-aid stations, toilets, wash facilities, lunchrooms, and similar areas.
- D. Common-Use Field Office: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel and meetings of 10 persons at Project site. Keep office clean and orderly.
- E. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on-site.
- F. Existing Stair and Service Elevator Usage: Use of Owner's existing stairs and service elevator will be permitted, as long as they are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore them to condition existing before initial use.
 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If, despite such protection, they become damaged, restore damaged areas so no evidence remains of correction work.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.
- B. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.
- C. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Vertical Openings: Close openings of 25 sq. ft. or less with plywood or similar materials.
 2. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
 3. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
- D. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
- E. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
 - a. Field Offices: Class A stored-pressure water-type extinguishers.
 - b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
 - c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
 2. Store combustible materials in containers in fire-safe locations.
 3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
 4. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
 5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
 6. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 7. Provide hoses for fire protection of sufficient length to reach construction areas. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
 2. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are the property of Contractor.
 2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section 01703 "Contract Closeout."

END OF SECTION 01500

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SECTION 01600 - MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing the Contractor's selection of products for use in the Project.
 - 1. Multiple Prime Contracts: Provisions of this Section apply to the construction activities of each prime contractor.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section 01421 "Reference Standards and Definitions" specifies the applicability of industry standards to products specified.
 - 2. Division 1 Section 01300 "Submittals" specifies requirements for submittal of the Contractor's Construction Schedule and the Submittal Schedule.
 - 3. Division 1 Section 01631 "Substitutions" specifies administrative procedures for handling requests for substitutions made after award of the Contract.

1.3 DEFINITIONS

- A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.
 - 1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - a. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
 - b. "Foreign Products," as distinguished from "domestic products," are items substantially manufactured (50 percent or more of value) outside the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of, nor living within, the United States and its possessions are also considered to be foreign products.

2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
3. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.

1.4 SUBMITTALS

- A. Product List: A list of products required is included at the end of this Section. Prepare a schedule in tabular form showing each product listed. Include the manufacturer's name and proprietary product names for each item listed.
- B. Product List: Prepare a list showing products specified in tabular form acceptable to the Architect. Include generic names of products required. Include the manufacturer's name and proprietary product names for each item listed.
 1. Coordinate product list with the Contractor's Construction Schedule and the Schedule of Submittals.
 2. Form: Prepare product list with information on each item tabulated under the following column headings:
 - a. Related Specification Section number.
 - b. Generic name used in Contract Documents.
 - c. Proprietary name, model number, and similar designations.
 - d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 - g. Projected delivery date or time span of delivery period.
 3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of an initial product list. Provide a written explanation for omissions of data and for known variations from Contract requirements.
 - a. At the Contractor's option, the initial submittal may be limited to product selections and designations that must be established early in the Contract period.
 4. Completed List: Within 30 days after date of commencement of the Work, submit 3 copies of the completed product list. Provide a written explanation for omissions of data and for known variations from Contract requirements.
 5. Architect's Action: The Architect will respond in writing to Contractor within 2 weeks of receipt of the completed product list. No response within this period constitutes no objection to listed manufacturers or products but does not constitute a waiver of the requirement that products comply with Contract Documents. The Architect's response will include a list of unacceptable product selections, containing a brief explanation of reasons for this action.

1.5 QUALITY ASSURANCE

- A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.
 - 1. When specified products are available only from sources that do not, or cannot, produce a quantity adequate to complete project requirements in a timely manner, consult with the Architect to determine the most important product qualities before proceeding. Qualities may include attributes, such as visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources producing products that possess these qualities, to the fullest extent possible.
- B. Compatibility of Options: When the Contractor is given the option of selecting between 2 or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.
 - 1. Each prime contractor is responsible for providing products and construction methods that are compatible with products and construction methods of other prime or separate contractors.
 - 2. If a dispute arises between prime contractors over concurrently selectable, but incompatible products, the Architect will determine which products shall be retained and which are incompatible and must be replaced.
- C. Foreign Product Limitations: Except under one or more of the following conditions, provide domestic products, not foreign products, for inclusion in the Work:
 - 1. No available domestic product complies with the Contract Documents.
 - 2. Domestic products that comply with the Contract Documents are available only at prices or terms substantially higher than foreign products that comply with the Contract Documents.
- D. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
 - 1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to the site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 - 5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
 - 6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.
 - 7. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.
 - 1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
 - 2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
- B. Product Selection Procedures: The Contract Documents and governing regulations govern product selection. Procedures governing product selection include the following:
 - 1. Proprietary Specification Requirements: Where Specifications name only a single product or manufacturer, provide the product indicated. No substitutions will be permitted.
 - 2. Semiproprietary Specification Requirements: Where Specifications name 2 or more products or manufacturers, provide 1 of the products indicated. No substitutions will be permitted.

- a. Where Specifications specify products or manufacturers by name, accompanied by the term "or equal" or "or approved equal," comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
3. Nonproprietary Specifications: When Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
4. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
5. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by the manufacturer for the application indicated.
 - a. Manufacturer's recommendations may be contained in published product literature or by the manufacturer's certification of performance.
6. Compliance with Standards, Codes, and Regulations: Where Specifications only require compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified.
7. Visual Matching: Where Specifications require matching an established Sample, the Architect's decision will be final on whether a proposed product matches satisfactorily.
 - a. Where no product available within the specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category.
8. Visual Selection: Where specified product requirements include the phrase "... as selected from manufacturer's standard colors, patterns, textures ..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern, and texture from the product line selected.
9. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division 1 for allowances that control product selection and for procedures required for processing such selections.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.

1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 01600

SECTION 01613 - DELIVERY, STORAGE, AND HANDLING (FF&E)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 DELIVERY

- A. Deliver and handle goods according to manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss.
- B. Schedule delivery to minimize long-term storage at the Project Site and to prevent overcrowding construction spaces. Coordinate delivery for items that are flammable, hazardous, easily damaged, or sensitive to deterioration or theft with installation time to ensure minimum holding time.
- C. Schedule and effect delivery of goods to take place at the times they are required for installation, unless otherwise specified.
- D. Deliver goods to the Project Site in manufacturer's original sealed container, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
- E. Inspect goods on delivery to ensure compliance with the Contract Documents and to ensure goods are undamaged and protected against damage.

3.2 STORAGE

- A. Store goods at the Project Site according to manufacturer's recommendations and in a manner that will facilitate inspection and measurement of quantity or counting of units. Store goods using means and methods that will prevent damage, deterioration, and theft or other loss.
- B. Store heavy goods in a manner that will not endanger building structure.

- C. Maintain temperature and humidity in areas where goods are stored within the range required by manufacturer's written instructions.

END OF SECTION 01613

SECTION 01631 - SUBSTITUTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for handling requests for substitutions made after award of the Contract.
 - 1. Multiple Prime Contracts: Provisions of this Section apply to the construction activities of each prime contractor.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section 01421 "Reference Standards and Definitions" specifies the applicability of industry standards to products specified.
 - 2. Division 1 Section 01300 "Submittals" specifies requirements for submitting the Contractor's Construction Schedule and the Submittal Schedule.
 - 3. Division 1 Section 01600 "Materials and Equipment" specifies requirements governing the Contractor's selection of products and product options.

1.3 DEFINITIONS

- A. Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction required by the Contract Documents proposed by the Contractor after award of the Contract are considered to be requests for substitutions. The following are not considered to be requests for substitutions:
 - 1. Substitutions requested during the bidding period, and accepted by Addendum prior to award of the Contract, are included in the Contract Documents and are not subject to requirements specified in this Section for substitutions.
 - 2. Revisions to the Contract Documents requested by the Owner or Architect.
 - 3. Specified options of products and construction methods included in the Contract Documents.
 - 4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.4 SUBMITTALS

- A. Substitution Request Submittal: The Architect will consider requests for substitution if received within 15 days after commencement of the Work. Requests received more than 15 days after commencement of the Work may be considered or rejected at the discretion of the Architect.
1. Submit 3 copies of each request for substitution for consideration. Submit requests in the form and according to procedures required for change-order proposals.
 2. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.
 3. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
 - a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate contractors, that will be necessary to accommodate the proposed substitution.
 - b. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements, such as performance, weight, size, durability, and visual effect.
 - c. Product Data, including Drawings and descriptions of products and fabrication and installation procedures.
 - d. Samples, where applicable or requested.
 - e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 - f. Cost information, including a proposal of the net change, if any in the Contract Sum.
 - g. The Contractor's certification that the proposed substitution conforms to requirements in the Contract Documents in every respect and is appropriate for the applications indicated.
 - h. The Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
 4. Architect's Action: If necessary, the Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. The Architect will notify the Contractor of acceptance or rejection of the substitution within 2 weeks of receipt of the request, or one week of receipt of additional information or documentation, whichever is later. Acceptance will be in the form of a change order.
 - a. Use the product specified if the Architect cannot make a decision on the use of a proposed substitute within the time allocated.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Conditions: The Architect will receive and consider the Contractor's request for substitution when one or more of the following conditions are satisfied, as determined by the Architect. If the following conditions are not satisfied, the Architect will return the requests without action except to record noncompliance with these requirements.
1. Extensive revisions to the Contract Documents are not required.
 2. Proposed changes are in keeping with the general intent of the Contract Documents.
 3. The request is timely, fully documented, and properly submitted.
 4. The specified product or method of construction cannot be provided within the Contract Time. The Architect will not consider the request if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
 5. The request is directly related to an "or-equal" clause or similar language in the Contract Documents.
 6. The requested substitution offers the Owner a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Owner must assume. The Owner's additional responsibilities may include compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner, and similar considerations.
 7. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
 8. The specified product or method of construction cannot be provided in a manner that is compatible with other materials and where the Contractor certifies that the substitution will overcome the incompatibility.
 9. The specified product or method of construction cannot be coordinated with other materials and where the Contractor certifies that the proposed substitution can be coordinated.
 10. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.
 11. Where a proposed substitution involves more than one prime contractor, each contractor shall cooperate with the other contractors involved to coordinate the Work, provide uniformity and consistency, and assure compatibility of products.
- B. The Contractor's submittal and the Architect's acceptance of Shop Drawings, Product Data, or Samples for construction activities not complying with the Contract Documents do not constitute an acceptable or valid request for substitution, nor do they constitute approval.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01631

SECTION 01703 – CONTRACT CLOSEOUT (FF&E)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout including, but not limited to, the following:
 - 1. Inspection and reinspection procedures at the Project's completion.
 - 2. Final acceptance of the Work allowances.
 - 3. Operation and maintenance manuals.
 - 4. Closeout procedures.
 - 5. Extra materials and spare parts.
 - 6. Warranties.
 - 7. Warranty inspections.
 - 8. Record documents.
 - 9. Final cleaning.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for Substantial Completion, complete the following. List exceptions in the request.
 - 1. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
 - 2. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete installation, and reasons the Work is not complete.
 - 3. Submit specific warranties, maintenance agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities.
 - 5. Submit Record Drawings, operation and maintenance manuals, final project photographs, damage or settlement surveys, and similar final record information.
 - 6. Deliver tools, spare parts, extra stock, and similar items.
 - 7. Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.
 - 8. Complete final cleanup requirements.
 - 9. Touch up and otherwise repair and restore marred, exposed finishes.

- B. Inspection Procedures: On receipt of a request for inspection, the Architect will either inspect or advise the Contractor of unfilled requirements.
 - 1. The Architect will make final inspection when the Work has been completed.

1.4 FINAL ACCEPTANCE

- A. Final Inspection: Request final inspection on completion of the following:
 - 1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for goods and completed operations where required.
 - 2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
 - 3. Submit a certified copy of the Architect's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and list has been endorsed and dated by the Architect.
 - 4. Submit consent of surety to final payment.
- B. Reinspection Procedure: The Architect will reinspect the Work on receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items for which completion has been delayed because of circumstances acceptable to the Architect.
 - 1. If necessary, reinspection will be repeated. Time will be assessed and charged by the Owner for more than one reinspection.

1.5 RECORD DOCUMENT SUBMITTALS

- A. Record Drawings: Maintain a clean, undamaged set of blue- or black-line white prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark which drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
 - 1. Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work.
 - 2. Note related Change Order numbers where applicable.
 - 3. Organize Record Drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
- B. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record keeping and submittals in connection with actual performance of the Work. Immediately before the date or dates of Substantial Completion, complete miscellaneous records and place in good order. Identify miscellaneous records properly and bind or file to be ready for continued use and reference. Submit to the Architect for the Owner's records.

- C. Operation and Maintenance Manuals: See requirements in Division 1 Section 01730 "Operation and Maintenance Data."

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

- A. Operation and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following:
1. Operation and maintenance manuals.
 2. Record documents.
 3. Spare parts and materials, including touchup paint.
 4. Tools.
 5. Lubricants.
 6. Identification systems.
 7. Hazards.
 8. Cleaning.
 9. Warranties.
 10. Maintenance agreements and similar continuing commitments.
 11. Inventory data on magnetic media.

3.2 FINAL CLEANING

- A. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean surfaces or units to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion:
 - a. Remove labels that are not permanent.
 - b. Clean exposed hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances.
 - c. Vacuum carpeted and upholstered surfaces.
 - d. Remove temporary protection.

END OF SECTION 01703

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SECTION 01710 - FINAL CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for final cleaning at Substantial Completion.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section 01600 "Temporary Facilities and Controls" specifies general cleanup and waste-removal requirements.
 - 2. Division 1 Section 01703 "Contract Closeout" specifies general contract closeout requirements.
 - 3. Special cleaning requirements for specific construction elements are included in appropriate Sections of Divisions 5 through 16.
- C. Multiple Prime Contracts: Each prime contractor is responsible for final cleaning his own Work. The Contractor for General Construction is responsible for coordinating final cleaning of an area or piece of equipment where more than one prime contractor is involved.
- D. Environmental Requirements: Conduct cleaning and waste-disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and antipollution regulations.
 - 1. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains.
 - 2. Burning or burying of debris, rubbish, or other waste material on the premises is not permitted.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Provide final-cleaning operations when indicated. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to the condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
- B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for the entire Project or a portion of the Project.
 - 1. Clean the Project Site, yard and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and foreign substances.
 - 2. Sweep paved areas broom clean. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - 3. Remove petrochemical spills, stains, and other foreign deposits.
 - 4. Remove tools, construction equipment, machinery, and surplus material from the site.
 - 5. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - 6. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - 7. Broom clean concrete floors in unoccupied spaces.
 - 8. Vacuum clean carpet and similar soft surfaces, removing debris and excess nap. Shampoo, if required.
 - 9. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - 10. Remove labels that are not permanent labels.
 - 11. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - 12. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - 13. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - 14. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

15. Clean ducts, blowers, and coils if units were operated without filters during construction.
 16. Clean food-service equipment to a sanitary condition, ready and acceptable for its intended use.
 17. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs and defective and noisy starters in fluorescent and mercury vapor fixtures.
 18. Leave the Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests. Comply with regulations of local authorities.
- D. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.
- E. Compliances: Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from the site and dispose of lawfully.
1. Where extra materials of value remain after completion of associated Work, they become the Owner's property. Dispose of these materials as directed by the Owner.

END OF SECTION 01710

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SECTION 01730 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for operation and maintenance manuals, including the following:
 - 1. Preparing and submitting operation and maintenance manuals for building operating systems and equipment.
 - 2. Preparing and submitting instruction manuals covering the care, preservation, and maintenance of architectural products and finishes.
 - 3. Instruction of the Owner's operating personnel in the operation and maintenance of building systems and equipment.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section 01300 "Submittals" specifies preparation of Shop Drawings and Product Data.
 - 2. Division 1 Section 01703 "Contract Closeout" specifies general closeout requirements.
 - 3. Division 1 Section 01703 "Contract Closeout" specifies general requirements for submitting project record documents.
 - 4. Appropriate Sections of Divisions 5 through 16 specify special operation and maintenance data requirements for specific pieces of equipment or building operating systems.
- C. Multiple Prime Contracts: Preparation of operation and maintenance manuals includes collecting material, collating and binding material, and submitting data. Each prime contractor shall prepare operation and maintenance data for its own installations.
 - 1. Where operation and maintenance manuals include information on installations by the Contractor for General Construction and another contractor, the Contractor for General Construction shall prepare the manuals.
 - 2. Where operation and maintenance manuals include information on installations by more than one prime contractor, other than the Contractor for General Construction, the Contractor who is the principal source of information, as determined by the Architect, shall receive information furnished by other contractors and prepare the manuals.
 - 3. Where instruction in operation and maintenance procedures on equipment and systems involves participation of more than one Contractor, the Contractor design-

nated by the Architect as the principal instructor shall coordinate with the other contractors for a mutually agreeable time to provide instruction to the Owner's operation and maintenance personnel.

1.3 QUALITY ASSURANCE

- A. Maintenance Manual Preparation: In preparation of maintenance manuals, use personnel thoroughly trained and experienced in operation and maintenance of equipment or system involved.
 - 1. Where maintenance manuals require written instructions, use personnel skilled in technical writing where necessary for communication of essential data.
 - 2. Where maintenance manuals require drawings or diagrams, use draftsmen capable of preparing drawings clearly in an understandable format.
- B. Instructions for the Owner's Personnel: Use experienced instructors thoroughly trained and experienced in operation and maintenance of equipment or system involved to instruct the Owner's operation and maintenance personnel.

1.4 SUBMITTALS

- A. Submittal Schedule: Comply with the following schedule for submitting operation and maintenance manuals:
 - 1. Before Substantial Completion, when each installation that requires operation and maintenance manuals is nominally complete, submit 2 draft copies of each manual to the Architect for review. Include a complete index or table of contents of each manual.
 - a. The Architect will return 1 copy of the draft with comments within 15 days of receipt.
 - 2. Submit 1 copy of data in final form at least 15 days before final inspection. The Architect will return this copy within 15 days after final inspection, with comments.
 - 3. After final inspection, make corrections or modifications to comply with the Architect's comments. Submit the specified number of copies of each approved manual to the Architect within 15 days of receipt of the Architect's comments.
- B. Form of Submittal: Prepare operation and maintenance manuals in the form of an instructional manual for use by the Owner's operating personnel. Organize into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder.
 - 1. Binders: For each manual, provide heavy-duty, commercial-quality, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to receive 8-1/2-by-11- inch paper. Provide a clear plastic sleeve on the spine to hold labels describing contents. Provide pockets in the covers to receive folded sheets.
 - a. Where 2 or more binders are necessary to accommodate data, correlate data in each binder into related groupings according to the Project Manual table

- of contents. Cross-reference other binders where necessary to provide essential information for proper operation or maintenance of the piece of equipment or system.
- b. Identify each binder on front and spine, with the printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter covered. Indicate volume number for multiple volume sets of manuals.
2. Dividers: Provide heavy paper dividers with celluloid-covered tabs for each separate Section. Mark each tab to indicate contents. Provide a typed description of the product and major parts of equipment included in the Section on each divider.
 3. Protective Plastic Jackets: Provide protective, transparent, plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
 4. Text Material: Where maintenance manuals require written material, use the manufacturer's standard printed material. If manufacturer's standard printed material is not available, provide specially prepared data, neatly typewritten, on **8-1/2-by-11-inch, 20-lb/sq. ft.** white bond paper.
 5. Drawings: Where maintenance manuals require drawings or diagrams, provide reinforced, punched binder tabs on drawings and bind in with text.
 - a. Where oversize drawings are necessary, fold drawings to the same size as text pages and use as a foldout.
 - b. If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in front or rear pocket of binder. Insert a typewritten page indicating drawing title, description of contents, and drawing location at the appropriate location in the manual.

1.5 MANUAL CONTENT

- A. In each manual include information specified in the individual Specification Section and the following information for each major component of building equipment and its controls:
 1. General system or equipment description.
 2. Design factors and assumptions.
 3. Copies of applicable Shop Drawings and Product Data.
 4. System or equipment identification, including:
 - a. Name of manufacturer.
 - b. Model number.
 - c. Serial number of each component.
 5. Operating instructions.
 6. Emergency instructions.
 7. Wiring diagrams.
 8. Inspection and test procedures.
 9. Maintenance procedures and schedules.
 10. Precautions against improper use and maintenance.
 11. Copies of warranties.
 12. Repair instructions including spare parts listing.
 13. Sources of required maintenance materials and related services.
 14. Manual index.

- B. Organize each manual into separate Sections for each piece of related equipment. As a minimum, each manual shall contain a title page; a table of contents; copies of Product Data, supplemented by Drawings and written text; and copies of each warranty, bond, and service contract issued.
1. Title Page: Provide a title page in a transparent, plastic envelope as the first sheet of each manual. Provide the following information:
 - a. Subject matter covered by the manual.
 - b. Name and address of the Project.
 - c. Date of submittal.
 - d. Name, address, and telephone number of the Contractor.
 - e. Name and address of the Architect.
 - f. Cross-reference to related systems in other operation and maintenance manuals.
 2. Table of Contents: After title page, include a typewritten table of contents for each volume, arranged systematically according to the Project Manual format. Include a list of each product included, identified by product name or other appropriate identifying symbol and indexed to the content of the volume.
 - a. Where a system requires more than one volume to accommodate data, provide a comprehensive table of contents for all volumes in each volume of the set.
 3. General Information: Provide a general information Section immediately following table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the subcontractor or Installer and the maintenance contractor. Clearly delineate the extent of responsibility of each of these entities. Include a local source for replacement parts and equipment.
 4. Product Data: Where the manuals include manufacturer's standard printed data, include only sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where the Project includes more than one item in a tabular format, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation, and delete references to information that is not applicable.
 5. Written Text: Prepare written text to provide necessary information where manufacturer's standard printed data is not available, and the information is necessary for proper operation and maintenance of equipment or systems. Prepare written text where it is necessary to provide additional information or to supplement data included in the manual. Organize text in a consistent format under separate headings for different procedures. Where necessary, provide a logical sequence of instruction for each operation or maintenance procedure.
 6. Drawings: Provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems or to provide control or flow diagrams. Coordinate these drawings with information contained in project record drawings to assure correct illustration of the completed installation.
 - a. Do not use original project record documents as part of operation and maintenance manuals.

7. Warranties, Bonds, and Service Contracts: Provide a copy of each warranty, bond, or service contract in the appropriate manual for the information of the Owner's operating personnel. Provide written data outlining procedures to follow in the event of product failure. List circumstances and conditions that would affect validity of warranty or bond.

1.6 MATERIAL AND FINISHES MAINTENANCE MANUAL

- A. Submit 3 copies of each manual, in final form, on material and finishes to the Architect for distribution. Provide one section for architectural products, including applied materials and finishes. Provide a second section for products designed for moisture protection and products exposed to the weather.
 1. Refer to individual Specification Sections for additional requirements on care and maintenance of materials and finishes.
- B. Architectural Products: Provide manufacturer's data and instructions on care and maintenance of architectural products, including applied materials and finishes.
 1. Manufacturer's Data: Provide complete information on architectural products, including the following, as applicable:
 - a. Manufacturer's catalog number.
 - b. Size.
 - c. Material composition.
 - d. Color.
 - e. Texture.
 - f. Reordering information for specially manufactured products.
 2. Care and Maintenance Instructions: Provide information on care and maintenance, including manufacturer's recommendations for types of cleaning agents to be used and methods of cleaning. Provide information on cleaning agents and methods that could prove detrimental to the product. Include manufacturer's recommended schedule for cleaning and maintenance.
- C. Moisture Protection and Products Exposed to the Weather: Provide complete manufacturer's data with instructions on inspection, maintenance, and repair of products exposed to the weather or designed for moisture-protection purposes.
 1. Manufacturer's Data: Provide manufacturer's data giving detailed information, including the following, as applicable:
 - a. Applicable standards.
 - b. Chemical composition.
 - c. Installation details.
 - d. Inspection procedures.
 - e. Maintenance information.
 - f. Repair procedures.
- D. Schedule: Provide complete information in the materials and finishes manual on products specified in the following Sections:
 1. Division 5 Section 05120 – Structural Steel.
 2. Division 8 Section 08110 – Steel Doors and Frames.

3. Division 8 Section 08710 – Door Hardware.
4. Division 9 Section 09900 – Painting.

1.7 EQUIPMENT AND SYSTEMS MAINTENANCE MANUAL

- A. Submit 6 copies of each manual, in final form, on equipment and systems to the Architect for distribution. Provide separate manuals for each unit of equipment, each operating system, and each electric and electronic system.
 1. Refer to individual Specification Sections for additional requirements on operation and maintenance of the various pieces of equipment and operating systems.
- B. Equipment and Systems: Provide the following information for each piece of equipment, each building operating system, and each electric or electronic system.
 1. Description: Provide a complete description of each unit and related component parts, including the following:
 - a. Equipment or system function.
 - b. Operating characteristics.
 - c. Limiting conditions.
 - d. Performance curves.
 - e. Engineering data and tests.
 - f. Complete nomenclature and number of replacement parts.
 2. Manufacturer's Information: For each manufacturer of a component part or piece of equipment, provide the following:
 - a. Printed operation and maintenance instructions.
 - b. Assembly drawings and diagrams required for maintenance.
 - c. List of items recommended to be stocked as spare parts.
 3. Maintenance Procedures: Provide information detailing essential maintenance procedures, including the following:
 - a. Routine operations.
 - b. Troubleshooting guide.
 - c. Disassembly, repair, and reassembly.
 - d. Alignment, adjusting, and checking.
 4. Operating Procedures: Provide information on equipment and system operating procedures, including the following:
 - a. Startup procedures.
 - b. Equipment or system break-in.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Instructions on stopping.
 - f. Shutdown and emergency instructions.
 - g. Summer and winter operating instructions.
 - h. Required sequences for electric or electronic systems.
 - i. Special operating instructions.
 5. Servicing Schedule: Provide a schedule of routine servicing and lubrication requirements, including a list of required lubricants for equipment with moving parts.

6. Controls: Provide a description of the sequence of operation and as-installed control diagrams by the control manufacturer for systems requiring controls.
 7. Coordination Drawings: Provide each Contractor's Coordination Drawings.
 - a. Provide as-installed, color-coded, piping diagrams, where required for identification.
 8. Valve Tags: Provide charts of valve-tag numbers, with the location and function of each valve.
 9. Circuit Directories: For electric and electronic systems, provide complete circuit directories of panelboards, including the following:
 - a. Electric service.
 - b. Controls.
 - c. Communication.
- C. Schedule: Provide complete information in the equipment and systems manual on products specified in the following Sections:
1. Division 16 Section 16515 – Interior Lighting.

1.8 INSTRUCTIONS FOR THE OWNER'S PERSONNEL

- A. Prior to final inspection, instruct the Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Provide instruction at mutually agreed upon times.
1. For equipment that requires seasonal operation, provide similar instruction during other seasons.
 2. Use operation and maintenance manuals for each piece of equipment or system as the basis of instruction. Review contents in detail to explain all aspects of operation and maintenance.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01730

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SECTION 01740 - WARRANTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturers standard warranties on products and special warranties.
 - 1. Refer to the General Conditions for terms of the Contractor's period for correction of the Work.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section 01300 "Submittals" specifies procedures for submitting warranties.
 - 2. Division 1 Section 01703 "Contract Closeout" specifies contract closeout procedures.
 - 3. Divisions 5 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.
 - 4. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.
- C. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- D. Separate Prime Contracts: Each prime contractor is responsible for warranties related to its own contract.

1.3 DEFINITIONS

- A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

- B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.4 WARRANTY REQUIREMENTS

- A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- D. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.
 - 1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
- E. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

1.5 SUBMITTALS

- A. Submit written warranties to the Architect prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.
 - 1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect within 15 days of completion of that designated portion of the Work.

- B. When the Contract Documents require the Contractor, or the Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner, through the Architect, for approval prior to final execution.
- C. Forms for special warranties are included at the end of this Section. Prepare a written document utilizing the appropriate form, ready for execution by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Submit a draft to the Owner, through the Architect, for approval prior to final execution.
 - 1. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
- D. Form of Submittal: At Final Completion compile 2 copies of each required warranty properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- E. Bind warranties and bonds in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address, and telephone number of the Installer.
 - 2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title or name, and name of the Contractor.
 - 3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 LIST OF WARRANTIES

- A. Schedule: Provide warranties on products and installations as specified in the following Sections:
 - 1. Division 2 through 16.

END OF SECTION 01740

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SECTION 05120 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes structural steel.
- B. This Section includes structural steel and architecturally exposed structural steel.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 09900 "Painting."

1.2 REFERENCE STANDARDS

- A. American Institute of Steel Construction
 - 1. Code of Standard Practice for Steel Buildings and Bridges.
 - 2. Seismic Provisions for Structural Steel Buildings.
- B. American Society for Testing and Materials
 - 1. ASTM A 6: Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use.
 - 2. ASTM A 36: Specifications for Carbon Structural Steel
 - 3. ASTM A 53: Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 4. ASTM A 108: Specification for Steel Bars, Carbon, Cold Finished, Standard Quality
 - 5. ASTM A 307: Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
 - 6. ASTM A 325: Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - 7. ASTM A 500: Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 - 8. ASTM A563: Specification for Carbon Alloy Steel Nuts
 - 9. ASTM A569: Standard Specification for Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip, Commercial
 - 10. ASTM A 780: Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - 11. ASTM C 1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
 - 12. ASTM E 94: Guide for Radiographic Testing
 - 13. ASTM E 142: Method for Controlling Quality of Radiographic Testing
 - 14. ASTM E 164: Practice for Ultrasonic Contact Examination of Weldments
 - 15. ASTM E 165: Test Method for Liquid Penetrant Examination
 - 16. ASTM E 709: Guide for Magnetic Particle Examination
 - 17. ASTM F436: Specification for Hardened Steel Washers
 - 18. ASTM F844: Specification for Washers Plain (Flat), Unhardened for General Use
 - 19. ASTM F 959: Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

C. American Welding Society

1. AWS D1.1: Structural Welding Code — Steel

D. Master Painter Institute

1. MPI #19: Inorganic Zinc Primer.

E. Research Council on Structural Connections

1. Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.

F. Steel Structures Painting Council

1. Painting System Guide No. 7.00. 1991.
2. SSPC–SP 10: Surface Preparation Specification No. 10: Near-White Blast Cleaning

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator.
- B. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional Engineer to prepare calculations and other structural data for structural steel connections.

1.4 SUBMITTALS

- A. Product Data for each type of product specified.
- B. Shop Drawings detailing fabrication of structural steel components.
 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.
 4. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.
- C. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of engineers and owners, and other information specified.
- D. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.
 1. Structural steel, including chemical and physical properties.
 2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 3. Direct-tension indicators.
 4. Shear stud connectors.
 5. Shop primers.
 6. Nonshrink grout.
 7. Welding Materials

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.
 - 1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:
 - a. Category: Category I, conventional steel structures.
 - b. Fabricator shall be registered with and approved by authorities having jurisdiction.
- C. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC's "Manual of Steel Construction (Allowable Stress Design) Ninth Edition.
 - 2. [ASTM A 6](#) "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
 - 3. Research Council on Structural Connections' (RCSC) "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the state of California and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.
- E. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."
 - 1. Present evidence that each welder is currently qualified in accordance with AWS requirements, has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 SEQUENCING

- A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel Shapes, Plates, and Bars: As follows:
 - 1. Carbon Steel: ASTM A 36.
- B. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B.
- C. Steel Pipe: ASTM A 53, Type E or S, Grade B.
 - 1. Weight Class: As shown
 - 2. Finish: Black, except where indicated to be galvanized.
- D. Anchor Rods, Bolts, Nuts, and Washers: As follows:
 - 1. Unheaded Rods: ASTM A 36.
 - 2. Headed Bolts: ASTM A 307, Grade A, carbon-steel, hex-head bolts; and carbon-steel nuts.
 - 3. Washers: ASTM A 844
 - 4. Nuts: ASTM A 563
- F. Nonhigh-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A carbon-steel, hex-head bolts; ASTM A 563 carbon-steel nuts; and ASTM A 844 flat, unhardened steel washers.
 - 1. Finish: Plain, uncoated.
- G. High-Strength Bolts, Nuts, and Washers: ASTM A 325 Type 1, heavy hex steel structural bolts, ASTM A 563 heavy hex carbon-steel nuts, and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Plain, uncoated.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325.
- H. Welding Electrodes: Comply with AWS requirements.

2.2 PRIMER

- A. Primer:
 - 1. At steel to receive fireproofing, do not prime unless specifically required by UL Design Number. Prime steel with primer approved by UL and listed in test data.
 - 2. At steel to receive primer, comply with requirements of Section 09900.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

2.4 FABRICATION

- A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.
 - 1. Assemble structural steel with mill camber upward.
 - 2. Identify high-strength structural steel according to ASTM A 6 and maintain markings until steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
 - 5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
 - 6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- B. Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
 - 1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
 - 2. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded.
- D. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.
- E. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's printed instructions.
- F. Steel Wall Framing: Select true and straight members for fabricating steel wall framing to be attached to structural steel framing. Straighten as required to provide uniform, square, and true members in completed wall framing.
- G. Welded Door Frames: Build up welded door frames attached to structural steel framing. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10 inches o.c., unless otherwise indicated.
- H. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.
 - 1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
 - 2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

2.5 SHOP CONNECTIONS

- A. Shop install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.
- B. Shop install and tighten high-strength bolts according to RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 1. Bolts: ASTM A 325 high-strength bolts, unless otherwise indicated.
 - 2. Connection Type: Slip-critical, unless indicated as snug tightened, direct-tension, or tensioned shear/bearing connections.
- C. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
 - 2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch and larger. Grind flush butt welds. Dress exposed welds.

2.6 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed-on fireproofing. Coordinate with 2.2.A.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications as follows:
 - 1. SSPC-SP 10 "Near-White Blast Cleaning."
- C. Priming: Immediately after surface preparation, shop-apply inorganic zinc primer coating according to manufacturer's instructions at rate recommended by SSPC to provide a dry film thickness of not less than 3 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
- D. Painting: Comply with Section 09900 for field applied paint systems.

2.7 SOURCE QUALITY CONTROL

- A. Government will engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
 - 2. Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- D. Shop-bolted connections will be tested and inspected according to RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.
- E. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
 - 4. Ultrasonic Inspection: ASTM E 164.
- F. Frequency of weld tests
 - 1. 100% of complete penetration groove weld shall be tested except the testing rate for an individual welder may be reduced to 25% if no rejection is found for 20 consecutive tests.
 - 2. 10% of fillet weld shall be tested. The most susceptible to failure welds shall be selected by the inspector. The testing rate shall be increased to 100% if the rejection rate is more than 5%.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.
- B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.
- B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
 3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
 - a. Comply with manufacturer's instructions for proprietary grout materials.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
1. Maintain erection tolerances of architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
 2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
- E. Splice members only where indicated.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Do not use thermal cutting during erection.
- H. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.
- 3.4 FIELD CONNECTIONS
- A. Install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.
- B. Install and tighten high-strength bolts according to RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
1. Bolts: ASTM A 325 high-strength bolts, unless otherwise indicated.
 2. Connection Type: Slip-critical, unless indicated as snug tightened, direct-tension, or tensioned shear/bearing connections.
- C. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch and larger. Grind flush butt welds. Dress exposed welds.

3.5 FIELD QUALITY CONTROL

- A. Government will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.
 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- D. Field-bolted connections will be tested and inspected according to RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.
- E. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.
 1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
 4. Ultrasonic Inspection: ASTM E 164.
- F. Frequency of weld tests
 1. 100% of complete penetration groove weld shall be tested.
 2. 25% of other welds shall be randomly selected and tested. If the rejection rate is over 5%, all welds shall be tested.

3.6 CLEANING

- A. Touchup Painting: Clean and touchup painting of field welds, bolted connections, and abraded areas of shop paint on structural steel.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

END OF SECTION 05120

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SECTION 08110 - STEEL DOORS, AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes steel doors, and frames.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 08710 "Door Hardware."
 - 2. Section 09255 "Gypsum Board Assemblies."
 - 3. Section 09900 "Painting."

1.2 REFERENCED STANDARDS

A. American National Standards Institute

ANSI A115 Series: A Collection of A115.1–A115.17, Specifications for Steel Door and Frame Preparation for Hardware

B. American Society for Testing and Materials

ASTM A 153: Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 366: Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality

ASTM A 569: Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality

ASTM A 620: Specification for Steel, Sheet, Carbon, Drawing Quality, Special Killed, Cold-Rolled

ASTM C 236: Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box

ASTM C 591: Specification for Unfaced Preformed Rigid Cellular Polyurethane Thermal Insulation

ASTM C 976: Test Method for Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box

ASTM E 413: Classification for Rating Sound Insulation

ASTM E 1408: Method for Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems

C. Steel Door Institute (SDI)

100: Recommended Specifications for Standard Steel Doors and Frames

105: Recommended Erection Instructions for Steel Frames

- 107: Hardware on Steel Doors (Reinforcement-Application)
- 108: Recommended Selection and Usage Guide for Standard Steel Doors
- 111 Series: 111A–111F: Recommended Details, Steel Doors and Frames
- 112: Galvanized Standard Steel Doors and Frames
- 117: Manufacturing Tolerances Standard Steel Doors and Frames

1.3 SUBMITTALS

- A. Product Data for each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes. Provide MSDS sheets for coatings, for core materials, and for finishing materials.
- B. Shop Drawings showing fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
- C. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Contract Drawings.
 - 1. Indicate coordination of glazing frames and stops with glass and glazing requirements.
- D. Samples for initial selection in the form of manufacturer's color charts showing the full range of colors available for factory-finished doors and frames.
- E. Samples for verification of each type of exposed finish required, prepared on Samples not less than 3 by 5 inches and of same thickness and material indicated for final unit of Work. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

1.4 QUALITY ASSURANCE

- A. Provide doors and frames complying with ANSI/SDI 100 "Recommended Specifications for Standard Steel Doors and Frames" and as specified.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Inspect doors and frames on delivery for damage. Minor damages may be repaired provided refinished items match new work and are acceptable to COR; otherwise, remove and replace damaged items as directed.
- C. Store doors and frames at building site under cover. Place units on minimum 4-inch- high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If cardboard wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Hot-Rolled Steel Sheets and Strip: Commercial-quality carbon steel, pickled and oiled, complying with [ASTM A 569](#).
- B. Cold-Rolled Steel Sheets: Carbon steel complying with [ASTM A 366](#), commercial quality, or [ASTM A 620](#), drawing quality, special killed.
- C. Supports and Anchors: Fabricated from not less than [0.0478-inch](#)- thick steel sheet; [0.0516-inch](#)-thick galvanized steel where used with galvanized steel frames.
- D. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize complying with ASTM A 153, Class C or D as applicable.

2.2 DOORS

- A. Steel Doors: Provide [1-3/4-inch](#) thick doors of materials and ANSI/SDI 100 grades and models specified below, or as indicated on Drawings or schedules:
 - 1. Interior Doors: Grade III, extra heavy-duty, Model 2A, seamless design, minimum [0.0747-inch](#)- thick cold-rolled steel sheet faces.

2.3 FRAMES

- A. Provide metal frames for doors, borrowed lights, and other openings, according to ANSI/SDI 100, and of types and styles as shown on Drawings and schedules. Conceal fastenings, unless otherwise indicated.
 - 1. Fabricate frames with mitered or coped corners, continuously welded construction for exterior applications and knocked down for field assembly at interior applications.
- B. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames.
- C. Plaster Guards: Provide minimum [0.0179-inch](#)- thick steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

2.4 FABRICATION

- A. Fabricate steel door and frame units to be rigid, neat in appearance, and free from defects, warp, or buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site. Comply with ANSI/SDI 100 requirements.

1. Internal Construction: One of the following manufacturer's standard core materials according to SDI standards:
 - a. Rigid polyurethane conforming to ASTM C 591.
 - b. Rigid polystyrene conforming to ASTM C 578.
 - c. Unitized steel grid.
 - d. Vertical steel stiffeners.
 - e. Rigid mineral fiber with internal sound deadener on inside of face sheets.
 2. Clearances: Not more than 1/8 inch at jambs and heads, except not more than 1/4 inch between non-fire-rated pairs of doors. Not more than 3/4 inch at bottom.
- B. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel sheet.
- C. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.
- E. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- F. Sound-Rated (Acoustical) Assemblies: Where shown or scheduled, provide door and frame assemblies fabricated as sound-reducing type, tested according to ASTM E 1408, and classified according to ASTM E 413.
1. Unless otherwise indicated, provide acoustical assemblies with STC sound ratings of 33 or better.
- G. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements of SDI 107 and ANSI A115 Series specifications for door and frame preparation for hardware.
1. For concealed overhead door closers, provide space, cutouts, reinforcing, and provisions for fastening in top rail of doors or head of frames, as applicable.
- H. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.
- I. Locate hardware as indicated on Shop Drawings or, if not indicated, according to the Door and Hardware Institute's (DHI) "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- 2.5 FINISHES, GENERAL
- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations relative to applying and designating finishes.

- B. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for steel sheet finishes.
- C. Apply primers and organic finishes to doors and frames after fabrication.

2.6 GALVANIZED STEEL SHEET FINISHES

- A. Surface Preparation: Clean surfaces with nonpetroleum solvent so that surfaces are free of oil or other contaminants. After cleaning, apply a conversion coating of the type suited to the organic coating applied over it.
- B. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply air-dried primer specified below immediately after cleaning and pretreatment.
 - 1. Shop Primer: Zinc-dust, zinc-oxide primer paint complying with performance requirements of FS TT-P-641, Type II.
- C. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat. Comply with paint manufacturer's instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 - 1. Color and Gloss: To match existing doors.

2.7 STEEL SHEET FINISHES

- A. Surface Preparation: Solvent-clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel to comply with SSPC-SP 5 (White Metal Blast Cleaning) or SSPC-SP 8 (Pickling).
- B. Pretreatment: Immediately after surface preparation, apply a conversion coating of type suited to organic coating applied over it.
- C. Factory Priming for Field-Painted Finish: Apply shop primer that complies with ANSI A224.1 acceptance criteria, is compatible with finish paint systems indicated, and has capability to provide a sound foundation for field-applied topcoats. Apply primer immediately after surface preparation and pretreatment.
- D. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat that complies with ANSI A250.3. Comply with paint manufacturer's instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 - 1. Color and Gloss: To match existing doors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.
- B. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 - 1. Except for frames located in existing gypsum board assembly construction, place frames before constructing enclosing walls and ceilings.
 - 2. In metal-stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In steel-stud partitions, attach wall anchors to studs with screws.
- C. Door Installation: Fit hollow-metal doors accurately in frames, within clearances specified in ANSI/SDI 100.

3.2 ADJUSTING AND CLEANING

- A. Prime Coat Touchup: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
- B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 08110

SECTION 08710 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide labor, materials, and equipment for door hardware, including but not limited to the following:
 - 1. Finish Hardware
 - 2. Identifying Devices
- B. Products furnished but not installed under this Section include:
 - 1. Final replacement cores and keys to be installed by Government.

1.2 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. ANSI A156 American National Standards Institute Series for Door Hardware

1.3 SUBMITTALS

- A. Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- B. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
 - a. Type, style, function, size, and finish of each hardware item.
 - b. Name and manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of each hardware set cross referenced to indications on Drawings both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for hardware.
 - g. Door and frame sizes and materials.
 - h. Keying information.
 - 2. Submittal Sequence: Submit initial draft of final schedule along with essential product data in order to facilitate the fabrication of other work that is critical in the Project construction schedule. Submit final schedule after samples, product data, coordination with shop drawings of other work, delivery schedules, and similar information has been completed and accepted.
 - 3. Keying Schedule: Submit separate detailed schedule indicating clearly how the Government's final instructions on keying of locks has been fulfilled.

- C. Samples of each type of exposed hardware unit in finish indicated and tagged with full description for coordination with schedule. Submit samples prior to submission of final hardware schedule.
 - 1. Samples will be returned to the supplier. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated in the Work, within limitations of keying coordination requirements.
- D. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
 - 1. The submission for templated and template list shall follow the procedure as set forth in the D.H.I. publication "For Processing Hardware Schedules and Templates."

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain each type of hardware, such as latch and lock sets, hinges, and closers, from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Government, COR, and Contractor, at reasonable times during the course of the Work, for consultation.
 - 1. Require supplier to meet with COR to finalize keying requirements and to obtain final instructions in writing.
- C. Quality levels of hardware are established by manufacturers' names and model numbers. Certain products are specified without substitution and shall be provided .

1.5 PRODUCT HANDLING

- A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.
- C. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.
- D. Deliver individually packaged door hardware items promptly to place of installation (Project site).
- E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.6 MAINTENANCE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Government's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide hardware that complies with barrier-free facilities design standards, such as:

1. Knob/Lever Heights
2. Knurled Knobs/Levers
3. Closer Opening Face
4. Kick Plates Height

2.2 SCHEDULED HARDWARE

- A. Requirements for design, grade, function, finish, size and other distinctive qualities of each type of finish hardware is indicated in the Hardware Schedule at the end of this section. Products are identified by using hardware designation numbers of the following.
- B. ANSI/BHMA designations used elsewhere in this section or in schedules to describe hardware items or to define quality or function are derived from the following standards. Provide products complying with these standards and requirements specified elsewhere in this section.

Butts and Hinges: ANSI A156.1 (BHMA 101)

Locks & Lock Trim: ANSI A156.2 (BHMA 601)

Door Controls- Closers: ANSI A156.4 (BHMA 301)

Template Hinge Dimensions: ANSI A156.7

Mortise Locks & Latches: ANSI A156.13 (BHMA 621)

Materials & Finishes: ANSI A156.18 (BHMA 1301)

2.3 MATERIAL AND FABRICATION

- A. Hand of door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
- B. Manufacturer's Name Plate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location. Remove removable nameplates, except in conjunction with required UL labels and as otherwise acceptable to COR. Manufacturer's identification will be permitted on rim of lock cylinders only.
- C. Base Metals: Produce hardware units of base metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially recognized) quality than specified for the applicable hardware units by applicable ANSI A156 series standard for each type hardware item and with ANSI A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods without written approval from COR.
- D. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.

- E. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws typically, except as otherwise indicated. Exposed fasteners shall match hardware finish or, if exposed in surfaces of other work, shall match Work as closely as possible.
- F. Provide concealed fasteners for hardware units which are exposed when door is closed, except to the extent no standard units of the type specified are available with concealed fasteners. Do not use through-bolts for installation where bolts head or nut opposite face is exposed in other work, except where it is not feasible to adequately reinforce the work. Where through-bolts cannot be avoided, provide sleeves for each through-bolt or use sex screw fasteners.
- G. Tools and Maintenance Instructions for Maintenance: Furnish a complete set of specialized tools and maintenance instructions as needed for Government's continued adjustment, maintenance, and removal and replacement of finish hardware.

2.4 FINISHED HARDWARE CRITERIA

A. Hinges And Butts:

- 1. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- 2. Screws: Furnish Phillips flat-head or machine screws for installation of units. Finish screw heads to match surface of hinges or pivots.
- 3. Hinges Pins: Except as otherwise indicated, provide pin as follows:
 - a. Steel Hinges: Steel pins
 - b. Interior Doors: Non-rising pins.
 - c. Tips: Flat button and matching plug, finished to match leaves.
 - d. Number of hinges: Typically, provide not less than 3 hinges per door leaf for doors 7 feet - 6 inches or less in height and one additional hinge for each 30 inches of additional height. Provide additional hinges where scheduled.

B. Lock Cylinders And Keying

- 1. Standard System: Provide new masterkey and grand masterkey system for Project in compliance with COR requirements.
- 2. Equip locks with manufacturer's standard 7-pin tumbler cylinder as available from Best Lock Company. No substitutions will be permitted.
- 3. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.
- 4. Comply with COR's instructions for masterkeying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks.
- 5. Key Material: Provide keys of nickel silver only.
- 6. Key Quantity: Furnish 2 change keys for each lock, 6 master keys for each master system, and 6 grandmaster keys for each grandmaster system.
 - a. Furnish one extra blank for each lock.
 - b. Deliver keys to COR.
- 7. Key Control System: Provide envelopes, labels, tags, self-locking key clips, receipt forms, 3-way visible card index, temporary marker, permanent marker, and standard metal cabinet, in accordance with written recommendations of the system manufacturer, with capacity for 150% of the number of locks required for the Project.

- a. Provide complete cross index system set up by key control manufacturer, and place keys on markers and hooks in the cabinet as determined by the final key schedule.

C. Locks, Latches And Bolts

1. Strikes: Provide Manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set.
2. Provide dust-proof strikes for foot bolts, except where special threshold construction provides non-recessed strike for bolt.
3. Provide roller type strike where recommended by manufacturer of the latch and lock units.
4. Provide 3/4 inch minimum throw on latch and deadlock bolts.
5. Flush Bolt Heads: Minimum of 1/2 inch diameter rods of brass, bronze or stainless steel, with minimum 12 inch long rod for doors up to 7' - 0" high. Provide longer rods as necessary for doors exceeding 7' - 0" in height.

D. Push/Pull Units:

1. Exposed Fasteners; Provide manufacturer's standard exposed fasteners for installation; thru-bolted for matched pairs, but not for single units

E. Closers And Door Control Devices:

1. Surface Applied Closer: Typically, provide parallel arms for overhead surface closers, except as otherwise indicated.
2. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use.
3. Barrier-Free Manual Closers: UFAS-compliant; except where manual closers are specifically scheduled at doors identified as not required to be accessible to the physically disabled, provide adjustable units complying with ANSI A117.1 provisions for door opening force and delayed action closing.

F. DOOR TRIM UNITS:

1. Fasteners: Provide manufacturer's standard exposed fastener for door trim units with either machine screws or self-tapping screws.
2. Fabricate protection plates (armor, kick or mop) not more than 2 inches less than door width on stop side and not more 1/2 inch less than door width on pull side, X the height indicated. Protection plates shall be beveled three (3) sides. Metal Plates: Stainless Steel, .050 inch (U.S. 18 ga.)

	<u>Height (inches)</u>	<u>by</u>	<u>Door Width (DW)</u>
Kickplate	8	x	DW Scheduled
Armor	48	x	DW Scheduled
Mop	4	x	DW Scheduled

PART 3 - EXECUTION

3.1 INSPECTION

- A. After installation has been completed, the finished hardware supplier shall have a qualified hardware consultant check the job and do a final inspection to determine that the doors and frames

were prepared properly to receive the hardware. The inspection shall also determine that the proper hardware was used on each opening according to the approved hardware schedule.

- B. The final inspection shall determine that hardware was installed according to the manufacturer's recommended instructions. Adjust hardware which is not operating properly.

3.2 INSTALLATION

- A. The mounting heights for the finishing hardware shall be as listed in the DHI Publication "Recommended Locations for Builders Hardware For Custom Steel Door and Frames."
- B. The handling of doors shall be as listed in the Finish Hardware Schedule and shall follow the DHI Publication "Basic Builders Hardware".
- C. The finish hardware installer shall be skilled and qualified in the installation of contract builders hardware.

3.3 ADJUSTING AND CLEANING

- A. Hardware shall be left clean and free from disfigurement, at final completion. The Contractor shall make final adjustment to all door closers and other hardware items. Defective or damaged items shall be repaired or replaced.

3.4 PROTECTION

- A. Provide proper protection for the hardware and finish until time of Substantial Completion of the Project.

3.5 FINISH HARDWARE SCHEDULE

Hardware Set #1

- 3 Hinges
- 1 Lockset, F6
- 1 Closer
- 1 Wall Stop

Hardware Set #2

- 4 Hinges
- 1 Lockset, F7
- 1 Closer
- 2 Kickplate
- 1 Wall Stop

Hardware Set #3

- 3 Hinges
- 1 Lockset, F7
- 1 Closer
- 1 Wall Stop
- 2 Kickplate

END OF SECTION 08710

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SECTION 09255 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Nonload-bearing steel framing members for interior gypsum board assemblies.
 - 2. Gypsum board assemblies attached to steel framing.

1.2 DEFINITIONS

- A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.3 ASSEMBLY PERFORMANCE REQUIREMENTS

- A. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those of assemblies whose STC ratings were determined according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1.4 SUBMITTALS

- A. Product Data for each type of product specified.
- B. Shop Drawings showing locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
- C. Product certificates signed by manufacturers of gypsum board assembly components certifying that their products comply with specified requirements.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, unless otherwise indicated.
- B. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.
- C. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 requirements or gypsum board manufacturer's recommendations, whichever are more stringent.

- B. Room Temperatures: For nonadhesive attachment of gypsum board to framing, maintain not less than 40 deg F. For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg F for 48 hours before application and continuously after until dry. Do not exceed 95 deg F when using temporary heat sources.
- C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Known Acceptable Sources: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

- 1. Steel Framing and Furring: Angeles Metal Systems
- 2. Grid Suspension Assemblies: Armstrong World Industries, Inc.
- 3. Gypsum Board and Related Products: USG, Company

2.2 STEEL FRAMING FOR WALLS AND PARTITIONS

- A. General: Provide steel framing members complying with the following requirements:
 - 1. Protective Coating: ASTM A 653, G 40 hot-dip galvanized coating for framing members attached to and within 10 feet of exterior walls.
- B. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch- wide minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
 - 1. Thickness: 0.0329 inch as follows:
 - a. For head runner, sill runner, jamb, and cripple studs at door and other openings.
 - b. In locations to receive cementitious backer units.
 - c. Where indicated.
 - 2.. Depth: 3-5/8 inches, unless otherwise indicated.
- C. Deflection Track: Manufacturer's standard top runner designed to prevent cracking of gypsum board applied to interior partitions resulting from deflection of the structure above fabricated from steel sheet complying with ASTM A 653 or ASTM A 568. Thickness as indicated for studs, and width to accommodate depth of studs, and of the following configuration:
 - 1. Top runner with 2-1/2-inch- deep flanges that either have V-shaped offsets that compress when pressure is applied from construction above or have slots 1 inch o.c. that allow fasteners attached to studs through the slots to accommodate structural movement by slipping.
 - a. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 1) Superior Flex Track System (SFT); Delta Star, Inc.
 - 2) SLP-TRK; Metal-Lite, Inc.
- D. Deflection and Firestop Track: Top runner designed to allow partition heads to expand and contract with movement of structure above while maintaining continuity of the assembly. Comply with

requirements of ASTM C 645 except configuration, of thickness indicated for studs and width to accommodate depth of studs indicated with flanges offset at midpoint to accommodate gypsum board thickness.

1. Offset Configuration: Shadow-line design with offset projecting out from depth of stud.
 2. Available Product: Subject to compliance with requirements, a product that may be incorporated in the Work includes, but is not limited to, "Fire Trak" manufactured by Fire Trak Corp.
- E. Steel Rigid Furring Channels: ASTM C 645, hat shaped, depth and minimum thickness of base (uncoated) metal as follows:
1. Thickness: 0.0329 inch, unless otherwise indicated.
 2. Depth: 7/8 inch, unless otherwise indicated.
- F. Furring Brackets: Serrated-arm type, adjustable, fabricated from corrosion-resistant steel sheet complying with ASTM C 645, minimum thickness of base (uncoated) metal of 0.0329 inch, designed for screw attachment to steel studs and steel rigid furring channels used for furring.
- G. Steel Resilient Furring Channels {(for use at Tech Center (3rd Floor) and Chorus and Band Rooms (1922 - ground floor))}: Manufacturer's standard product designed to reduce sound transmission, fabricated from steel sheet complying with ASTM A 653 or ASTM A 568 to form 1/2-inch- deep channel of the following configuration:
1. Single- or Double-Leg Configuration: Asymmetric-shaped channel with face connected to a single flange by a single-slotted leg (web) or hat-shaped channel, with 1-1/2-inch- wide face connected to flanges by double-slotted or expanded-metal legs (webs).
- H. Z-Furring Members: Manufacturer's standard Z-shaped furring members with slotted or nonslotted web, fabricated from steel sheet complying with ASTM A 653 or ASTM A 568; with a minimum base metal (uncoated) thickness of 0.0179 inch, face flange of 1-1/4 inch, wall-attachment flange of 7/8 inch, and of depth required to fit insulation thickness indicated.
- I. Steel Channel Bridging: Cold-rolled steel, 0.0598-inch minimum thickness of base (uncoated) metal and 7/16-inch- wide flanges, 1-1/2 inches deep, 475 lb/1000 feet, unless otherwise indicated.
- J. Steel Flat Strap and Backing Plate: Steel sheet for blocking and bracing complying with ASTM A 653 or ASTM A 568, length and width as indicated, and with a minimum base metal (uncoated) thickness as follows:
1. Thickness: 0.0329 inch unless otherwise indicated.
- K. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

2.3 GYPSUM BOARD PRODUCTS

- A. General: Provide gypsum board of types indicated in maximum lengths available that will minimize end-to-end butt joints in each area indicated to receive gypsum board application.
1. Widths: Provide gypsum board in widths of 48 inches.
- B. Gypsum Wallboard: ASTM C 36 and as follows:
1. Type: Regular for vertical surfaces, unless otherwise indicated.
 2. Type: Type X where required for fire-resistance-rated assemblies.
 3. Type: Sag-resistant type for ceiling surfaces.
 4. Edges: Tapered.
 - 5.. Thickness: 5/8 inch unless otherwise indicated.

2.4 TRIM ACCESSORIES

- A. Accessories for Interior Installation: Cornerbead, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:
 - 1. Material: Formed metal complying with the following requirement:
 - a. Steel sheet zinc coated by hot-dip process or rolled zinc.
 - 2. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047:
 - a. Cornerbead on outside corners, unless otherwise indicated.
 - b. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim, unless otherwise indicated.
 - c. L-bead with face flange only; face flange formed to receive joint compound. Use L-bead where indicated or where otherwise shown.
 - d. One-piece control joint formed with V-shaped slot and removable strip covering slot opening.
- B. Accessory for Curved Edges: Cornerbead formed of metal, plastic, or metal combined with plastic, with either notched or flexible flanges that are bendable to curvature radius.
- C. Accessories for Exterior Installations: Cornerbead, edge trim, and control joints formed from rolled zinc complying with ASTM C 1047, in shapes indicated below by reference to Fig. 1 designations in ASTM C 1047.
 - 1. Cornerbead on outside corners, unless otherwise indicated.
 - 2. Edge trim complying with shape LC-bead per Fig. 1, unless otherwise indicated.
 - 3. One-piece control joint formed from rolled zinc with V-shaped slot and removable strip covering slot opening.

2.5 JOINT TREATMENT MATERIALS

- A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.
- B. Joint Tape for Gypsum Board: Paper reinforcing tape, unless otherwise indicated.
 - 1. Use pressure-sensitive or staple-attached, open-weave, glass-fiber reinforcing tape with compatible joint compound where recommended by manufacturer of gypsum board and joint treatment materials for application indicated.
- C. Joint Compound for Cementitious Backer Units: Material recommended by cementitious backer unit manufacturer.

2.6 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following requirements:
 - 1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.
- C. Available Products: Subject to compliance with requirements, acoustical sealants that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Acoustical Sealant for Exposed and Concealed Joints:

- a. PL Acoustical Sealant; ChemRex, Inc.; Contech Brands.
 - b. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.
 - c. SHEETROCK Acoustical Sealant; United States Gypsum Co.
2. Acoustical Sealant for Concealed Joints:
 - a. BA-98; Pecora Corp.
 - b. Tremco Acoustical Sealant; Tremco, Inc.

2.7 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.
- B. Laminating Adhesive: Special adhesive or joint compound recommended for laminating gypsum panels.
- C. Spot Grout: ASTM C 475, setting-type joint compound recommended for spot-grouting hollow metal door frames.
- D. Fastening Adhesive for Metal: Special adhesive recommended for laminating gypsum panels to steel framing.
- E. Steel drill screws complying with ASTM C 1002 for the following applications:
 1. Fastening gypsum board to steel members less than 0.033 inch thick.
- F. Steel drill screws complying with ASTM C 954 for fastening gypsum board to steel members from 0.033 to 0.112 inch thick.
- G. Steel drill screws of size and type recommended by unit manufacturer for fastening cementitious backer units.
- H. Gypsum Board Nails: ASTM C 514.
- I. Foam Gaskets: Closed-cell vinyl foam adhesive-backed strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit metal stud size indicated.
- J. Sound-Attenuation Blankets: Unfaced mineral-fiber blanket insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type 4 (blankets without membrane facing).
 1. Mineral-Fiber Type: Fibers manufactured from slag wool or rock wool.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Ceiling Anchorages: Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.

1. Furnish concrete inserts and other devices indicated to other trades for installation well in advance of time needed for coordination with other construction.
- B. Where offset anchor plates are required, provide continuous units fastened to building structure not more than 24 inches o.c.

3.3 INSTALLING STEEL FRAMING, GENERAL

- A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with United States Gypsum Co.'s "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings.
 1. Where building structure abuts ceiling perimeter or penetrates ceiling.
 2. Where partition framing and wall furring abut structure, except at floor.
 - a. Provide slip- or cushioned-type joints as detailed to attain lateral support and avoid axial loading.
 - b. Install deflection track top runner to attain lateral support and avoid axial loading.
 - c. Install deflection and firestop track top runner at fire-resistance-rated assemblies where indicated.
 - 1) Attach jamb studs at openings to tracks using manufacturer's standard stud clip.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.

3.4 INSTALLING STEEL FRAMING FOR WALLS AND PARTITIONS

- A. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.
 1. Where studs are installed directly against exterior walls, install asphalt felt strips or foam gaskets between studs and wall.
- B. Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
 1. Cut studs 1/2 inch short of full height to provide perimeter relief.
 2. For STC-rated and fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid structural surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed, to support gypsum board closures needed to make partitions continuous from floor to underside of solid structure.
- D. Terminate partition framing at suspended ceilings where indicated.
- E. Install steel studs and furring in sizes and at spacings indicated.
 1. Single-Layer Construction: Space studs 16 inches o.c., unless otherwise indicated.
- F. Install steel studs so flanges point in the same direction and leading edge or end of each gypsum board panel can be attached to open (unsupported) edges of stud flanges first.

- G. Frame door openings to comply with GA-219, and with applicable published recommendations of gypsum board manufacturer, unless otherwise indicated. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1. Install 2 studs at each jamb, unless otherwise indicated.
 - 2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.
 - 3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- H. Frame openings other than door openings to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.

3.5 APPLYING AND FINISHING GYPSUM BOARD, GENERAL

- A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840 and GA-216.
- B. Install sound-attenuation blankets, where indicated, prior to installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
- C. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Avoid joints other than control joints at corners of framed openings where possible.
- E. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- F. Attach gypsum panels to framing provided at openings and cutouts.
- G. Spot grout hollow metal door frames for solid-core wood doors, hollow metal doors, and doors over 32 inches wide. Apply spot grout at each jamb anchor clip and immediately insert gypsum panels into frames.
- H. Form control and expansion joints at locations indicated and as detailed, with space between edges of adjoining gypsum panels, as well as supporting framing behind gypsum panels.
- I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces such as above ceilings, except in chases that are braced internally.
 - 1. Except where concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 4. Fit gypsum panels around ducts, pipes, and conduits.
 - 5. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- J. Isolate perimeter of nonload-bearing gypsum board partitions at structural abutments, except floors, as detailed. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with U-bead

edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- K. Where STC-rated gypsum board assemblies are indicated, seal construction at perimeters, behind control and expansion joints, openings, and penetrations with a continuous bead of acoustical sealant including a bead at both faces of the partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
- L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.
 - 1. Space screws a maximum of 12 inches o.c. for vertical applications unless indicated otherwise.
 - 2. Follow proprietary requirements for fire-rated assemblies.
- M. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

3.4 GYPSUM BOARD APPLICATION METHODS

- A. Single-Layer Application: Install gypsum wallboard panels as follows:
 - 1. On ceilings, apply gypsum panels prior to wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated, and provide panel lengths that will minimize end joints.
 - 3. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless parallel application is required for fire-resistance-rated assemblies. Use maximum-length panels to minimize end joints.
 - c. Stagger abutting end joints not less than one framing member in alternate courses of board.
 - d. At stairwells and other high walls, install panels horizontally.
 - 4. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
- B. Single-Layer Fastening Methods: Apply gypsum panels to supports as follows:
 - 4. Fasten with screws.
- C. Direct-Bonding to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's recommendations, and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.
- B. Install cornerbead at external corners.
- C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.
 - 1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
 - 2. Install L-bead where edge trim can only be installed after gypsum panels are installed.

- 3. Install U-bead where indicated.
- D. Install control joints at intervals recommended by wallboard manufacturer for system used.
- E. Install control joints according to ASTM C 840 and manufacturer's recommendations and in specific locations approved by Architect for visual effect.

3.6 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, flanges of cornerbead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.
- B. Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.
- C. Apply joint tape over gypsum board joints, except those with trim accessories having flanges not requiring tape.
- D. Apply joint tape over gypsum board joints and to flanges of trim accessories as recommended by trim accessory manufacturer.
- E. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA-214.
 - 1. Level 4 for gypsum board surfaces, unless otherwise indicated.
- F. Use the following joint compound combination as applicable to the finish levels specified:
 - 1. Embedding and First Coat: Setting-type joint compound. Fill (Second) Coat: Setting-type joint compound. Finish (Third) Coat: Ready-mixed, drying-type, all-purpose or topping compound.
 - 2. Embedding and First Coat: Ready-mixed, drying-type, all-purpose or taping compound. Fill (Second) Coat: Ready-mixed, drying-type, all-purpose or topping compound. Finish (Third) Coat: Ready-mixed, drying-type, all-purpose or topping compound.
- G. For Level 4 gypsum board finish, and unless otherwise indicated, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration. Provide skim coat at wainscot type ~~to~~ to be feathered 12" above top cap and from ends of all paneling

3.7 CLEANING AND PROTECTION

- E. Promptly remove any residual joint compound from adjacent surfaces.
- F. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure gypsum board assemblies are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 09255

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SECTION 09900 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes typical painting of interior surfaces.

1.2 SUBMITTALS

- A. Product Data: For each paint system specified. Include block fillers and primers.
 - 1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
 - 3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- B. Samples for Verification: Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
 - 1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 - 2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.

1.3 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project .
- B. Single-Source Responsibility: Provide primers and undercoat material produced by the same manufacturer as the finish coats for each type of coating. Use only thinners recommended by the manufacturer and only within recommended limits.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.
 - 8. VOC content.
 - 9. Handling instructions and precautions.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.5 PROJECT CONDITIONS

- A. Apply coatings only when the temperature of surfaces to be coated and surrounding air temperatures are between 45 and 95 deg F.
- B. Do not apply coatings in rain, fog, or mist; or when the relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
 1. Allow wet surfaces to dry thoroughly and attain the temperature and conditions specified before proceeding with or continuing coating operation.
 2. Work may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
- C. Paint exposed surfaces whether or not colors are designated in "schedules," except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the COR will select from standard colors or finishes available.
 1. Painting includes field-painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
 2. Colors: The COR will furnish a schedule of colors for each area and surface. All colors shall be mixed in accordance with the manufacturers instructions. The number of coats required to ensure adequate and complete coverage in the opinion of the COR shall not necessarily be limited to the number of coats specified in the Painting Schedule contained in this Section. More than one color may be used on any wall surface with straight line separation between colors at no additional cost to the Owner. The COR reserves the right to select at no additional cost, bright or accent colors in quantity amounting to 20 percent of the total interior wall surface area to be painted.
 3. Colors of priming coats (and body coats where specified) shall be lighter than those of finish coat.
- D. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.
 1. Prefinished items not to be painted shall include, but are not limited to, the following factory-finished components:
 - b. Acoustic materials.
 - a. Finished mechanical and electrical equipment.
 - b. Light fixtures.
 - c. Switchgear.
 - d. Distribution cabinets.
 2. Concealed surfaces not to be painted include wall or ceiling surfaces in the following generally inaccessible areas:
 - a. Foundation spaces.
 - b. Furred areas.
 - c. Utility tunnels.
 - d. Pipe spaces.
 - e. Duct shafts.
 3. Finished metal surfaces not to be painted include:

- a. Factory painted items.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper.
 - e. Bronze.
 - f. Brass.
4. Operating parts not to be painted include moving parts of operating equipment, such as the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
5. Labels: Do not paint over Underwriters Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.6 SUBMITTALS

- A. Product data for each paint system specified, including block fillers and primers.
 1. Provide the manufacturer's technical information including label analysis and instructions for handling, storage, and application of each material proposed for use.
 2. List each material and cross-reference the specific coating, finish system, and application. Identify each material by the manufacturer's catalog number and general classification.
 3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- B. Samples for initial color selection in the form of manufacturer's color charts.
 1. After color selection, the COR will furnish color chips and color schedule for surfaces to be coated.
- C. List: Submit paint and coating materials list giving the manufacturer's name, product name and product number for each material.
- D. Samples for Verification Purposes: Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.
 1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
 2. Provide a list of material and application for each coat of each sample. Label each sample as to location and application.

1.7 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to those indicated for the Project that have resulted in a construction record of successful in-service performance.
- B. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.
- C. Field Samples: On wall surfaces and other exterior and interior components, duplicate finishes of prepared samples. Provide full-coat finish samples on at least 100 sq. ft. of surface until required sheen, color, and texture are obtained; simulate finished lighting conditions for review of in-place work.

1. Final acceptance of colors will be from job-applied samples.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
 1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
 1. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.9 JOB CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F and 90 deg F.
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F and 95 deg F.
- C. Do not apply paint in rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 F deg above the dew point; or to damp or wet surfaces.
 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed within temperature limits specified by the manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 1. Devoe and Raynolds Co. (Devoe).
 2. Fuller O'Brien (Fuller).
 3. The Glidden Company (Glidden).
 4. Benjamin Moore and Co. (Moore).
 5. PPG Industries, Pittsburgh Paints (PPG).
 6. Pratt and Lambert (P & L).
 7. The Sherwin-Williams Company (S-W).

2.2 INTERIOR PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.
- B. Material Quality: Provide the manufacturer's paint material equal to or better than Benjamin Moore best quality of the various coating types specified.. Paint material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish the manufacturer's material data and certificates of performance for proposed substitutions. Include percentage of pigment content and other materials.

2.3 PRIMERS

- A. Primers: Provide the manufacturer's recommended factory-formulated primers that are compatible with the substrate and finish coats indicated.

- 1. Gypsum Drywall Primer: White interior latex-based primer.

2.4 UNDERCOAT MATERIALS

- A. Undercoat Materials: Provide the manufacturer's recommended factory-formulated undercoat materials that are compatible with the substrate and finish coats indicated.
 - 1. Interior Enamel Undercoat: Ready-mixed alkyd enamel.

2.5 INTERIOR FINISH PAINT MATERIAL

- A. Finish Paint: Provide the manufacturer's recommended factory-formulated finish-coat materials that are compatible with the substrate and undercoats indicated.
 - 1. Gypsum Wallboard and Existing Plaster: Interior, Latex-Based Paint, Ready-mixed, latex-based paint.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions under which painting will be performed for compliance with paint application requirements. Surfaces receiving paint must be thoroughly dry before paint is applied.
 - 1. Do not begin to apply paint until unsatisfactory conditions have been corrected.
 - 2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify the COR about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items, if necessary, to completely paint the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease prior to cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to the manufacturer's instructions for each particular substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers and previously coated surfaces or remove and reprime. Notify COR in writing about anticipated problems using the specified finish-coat material with substrates primed by others.
 - 2. Ferrous Metals: Clean nongalvanized, ferrous metal surfaces that have not been shop-coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council (SSPC).
 - a. Blast steel surfaces clean as recommended by the paint system manufacturer and according to requirements of SSPC specification SSPC-SP 10.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.

- D. Materials Preparation: Carefully mix and prepare paint materials according to manufacturer's directions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
 - 3. Use only thinners approved by the paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - 1. Paint colors, surface treatments, and finishes are to be provided by the COR.
 - 2. Provide primer coats that are compatible with finish coats used.
 - 3. The number of coats and the film thickness required are the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce a smooth even surface according to the manufacturer's directions.
 - 4. Apply additional coats if undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
 - 5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 - 6. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 7. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint.
 - 8. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 - 9. Sand lightly between each succeeding enamel or varnish coat.
 - 10. Omit primer on metal surfaces that have been shop-primed and touch-up painted.
- C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - 1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm and does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
- D. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to the manufacturer's directions.

1. Brushes: Use brushes best suited for the material applied.
 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
- E. Minimum Coating Thickness: Apply materials no thinner than the manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer for color scheduled.
- F. Mechanical and Electrical Work: Painting mechanical and electrical work is limited to items exposed in mechanical equipment rooms and in occupied spaces.
- G. Mechanical items to be painted include, but are not limited to, the following:
1. Ductwork.
 2. Insulation.
 3. Supports.
 4. Motors and mechanical equipment.
 5. Accessory items.
- H. Electrical items to be painted include, but are not limited to, the following:
1. Conduit and fittings.
- I. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime-coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appear, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- J. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.
- K. Pigmented (Opaque) Finishes: Completely cover to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- L. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.
1. Provide satin finish for final coats.
- M. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with specified requirements.
- 3.4 CLEANING
- A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.
- 3.5 PROTECTION
- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to COR.

- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
 - 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINT SCHEDULE

- A. General: Provide the following paint systems for the various substrates, as indicated.
- B. Gypsum Drywall Systems:
 - 1. Lusterless (Flat) Emulsion Finish: Two coats.
 - a. Primer: White, interior, latex-based primer.
 - b. Finish Coat: Interior, satin, latex-based paint.
 - 2. Semigloss Enamel Finish: Three coats with total dry film thickness not less than 2.5 mils.
 - a. Primer: Interior, flat, latex-based paint.
 - b. Undercoat: Interior enamel undercoat.
 - c. Finish Coat: Interior, semigloss, odorless, alkyd enamel.
- C. Galvanized metal:
 - 1. Alkyd Enamel Finish: High quality, gloss or semi-gloss, medium long oil alkyd finish shall have a minimum solids content of 49 percent by volume. Primer shall be as recommended by manufacturer.
 - a. Prime Coat: DFT= 3 mils Ameron 5105, Tnemec 4-55, or equal.
 - b. Finish Coats: Two or more, DFT= 3 mils, Ameron 5401 HS, Tnemec 2H, or equal.
 - c. Total system DFT = 6 mils.

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SECTION 15010 - GENERAL REQUIREMENTS FOR MECHANICAL WORK

PART 1 - GENERAL

1.1 SUMMARY:

Furnish labor, materials, equipment and incidentals necessary for complete and operational mechanical systems, as specified herein.

1.2 RELATED WORK COVERED ELSEWHERE:

- A. This section, as well as Division 1, concerns all other sections in Division 15 MECHANICAL, and shall be considered a part of each of those sections as if written in their entirety.

1.3 QUALITY ASSURANCE:

A. CONTRACTORS' QUALIFICATIONS:

Use skilled workmen, trained and experienced in their crafts, and who are familiar with the specifications and methods of performing the work in this division. All workmen shall be properly licensed.

B. WORKMANSHIP:

Work shall be performed in accordance with quality, commercial practices. The appearance of finished work shall be of equal importance with its operation. Materials and equipment shall be installed based upon the actual dimensions and conditions at the project site. Locations for materials or equipment requiring an exact fit shall be field measured. Equipment and duct system shall be isolated to avoid unacceptable noise levels from objectionable vibrations from all systems without cost to the Government.

C. CONTRACT DRAWINGS:

Where the mechanical drawings indicate (diagrammatically or otherwise) the work intended and the functions to be performed, even though some minor details are not shown, the Contractor shall furnish all equipment, material, and labor to complete the installation work, and accomplish all indicated functions of the mechanical installation. Further, the Contractor shall be responsible for taking the necessary actions to ensure that all mechanical work is coordinated and compatible with architectural, electrical and structural plans.

D. CERTIFICATION:

Air moving equipment shall be certified by the AMCA (Air Movement and Control Association.) The electrical components shall bear the label of the U.L. (Underwriter's Laboratories Inc.). Air conditioning systems shall be certified by the ARI (Air Conditioning Refrigeration Institute).

E. FACTORY TESTING:

Packaged equipment shall be assembled and tested at the factory before shipment to the project.

1.4 SUBMITTALS:

Submittals shall be in accordance with Section 01300 and shall include:

- A. Component catalog number and manufacturing data sheet, indicating pertinent data and identifying each component by the item number and nomenclature as specified.
- B. Component drawings showing dimensions, mounting, and external connection details.
- C. Factory product data sheets showing engineering data and performance criteria for each unit. Information shall include equipment performance rating and electrical characteristics.
- D. Furnish appropriate information specified in this Division to be included in the Operation and Maintenance Manual.
- E. Within 15 days after award of the Contract and before orders are placed or shop drawings are submitted, the Contractor shall submit to the Contracting Officer a list of equipment and principal materials specified. Give names of manufacturers, catalog and model numbers, and such other supplementary information as necessary for identification.
- F. Shop drawings shall be submitted for equipment not completely identifiable by information submitted on the materials and equipment lists, and whenever requested by the Contracting Officer. Shop Drawings shall be submitted in accordance with Section 01300.
- G. In addition to number of copies of Shop Drawings and other data required for review submittals, maintain a separate file of final approved copies. Deliver approved copies to the Contractor who shall include them as part of the O&M manuals. Incorporate changes and revisions made throughout the construction period. Delivery of approved copies is a condition of final acceptance for the project.
- H. Maintain "As-Built" Drawings to be included in the O&M Manuals. Maintain a set of "Blue-Line" Prints and indicate changes and diagrams of those portions of work in which actual construction is significantly at variance with the Contract Drawings. Mark the Drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, drawings clearly indicating locations of all devices, equipment and other pertinent items, as installed. Upon completion of the project, submit all materials to the Contracting Officer, after verifying all the above data is shown correctly.
- I. In addition to information specified to be included in the maintenance manuals include recommended periodic maintenance tasks and schedule including procedures for accomplishment of repair and overhaul procedures including:
 - 1. Performance data and operation units.
 - 2. Troubleshooting chart including symptoms, probable causes and remedial action

required.

3. Adjustment specifications and procedures.
4. Fits and tolerances (mechanical wear limits and electrical values at specified test points).
5. List of special tools and/or test equipment required to accomplish any of the above troubleshooting adjustments, repair or overhaul procedures.
6. List of recommended spare parts and consumable items required to support 1 year's use of the item. List shall completely identify the item and indicate the source where they may be procured.

1.5 STANDARDS AND REFERENCES:

- A. Mechanical work shall be executed in accordance with the latest edition of local, State and national codes, ordinances and regulations which have jurisdiction or authority over the work. If conflicts occur between other documents, the most stringent shall apply. The applicable provisions and recommendations of the standards listed under the individual sections in Division 15 shall be complied with as if written in their entirety.
- B. Perform work to meet or exceed the requirements of the Uniform Building Code, Uniform Mechanical Code, Uniform Plumbing Code and other applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction. Resolve any code violation discovered in the Contract Documents with the Contracting Officer prior to award of the Contract. After award of the Contract, make any corrections or additions necessary for compliance with applicable codes at no additional cost to the Government.

1.6 DELIVERY AND STORAGE:

Follow the manufacturer's directions for the delivery, storage and handling of equipment and materials. Tightly cover equipment and materials and protect it from dirt, water, chemical or mechanical injury and theft. Damaged equipment shall not be acceptable. Upon installation, protect the materials until the work is completed and accepted by the Government.

1.7 JOB CONDITIONS:

- A. Obtain and pay for all permits, licenses and inspections as required by law for the completion of the work. Comply with the requirements of the applicable utility companies serving this project. Make all arrangements with the utility companies for proper coordination of the work. Certificates of approval shall be secured, paid for, and delivered to the Contracting Officer before receiving the final acceptance of the work.
- B. The location of materials, equipment, devices and appliances indicated are approximate and subject to revisions at the time the work is installed. The Contract Drawings are diagrammatic only, and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.
- C. Should project conditions require any rearrangement of work, or if equipment or

accessories can be installed to a better advantage than the general arrangement of work on the plans, the Contractor may, before proceeding with the work, prepare and submit plans of the proposed rearrangement for review by the Contracting Officer.

- D. Some mechanical equipment sizes indicated on the Drawings are based on a particular manufacturer. It is the responsibility of the Contractor to verify that the equipment he proposes to furnish will fit in the space indicated on the Drawings. Refer to Architectural and Structural Drawings for building dimensions.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Materials and equipment shall conform to respective publications and any other requirements specified below. Materials and equipment, to be acceptable, must comply with all contract requirements. Materials to be furnished by the Contractor under this specification shall be of manufacturer regularly engaged in the production of such materials and of the manufacturer's latest designs that comply with the specification requirements.
- B. All structural and miscellaneous steel used in connection with mechanical work and located outdoors or in damp locations shall be hot-dip galvanized unless otherwise specified. Galvanizing shall average 2.0 ounce per square foot and shall conform to ASTM A123.
- C. The Contractor shall provide all special servicing tools required for equipment provided under this division.
- D. Approval of materials and equipment will be based on the manufacturer's printed data. The label or listing of Underwriter's Laboratories, Inc. (UL) or ETL, will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures of UL, and that the materials and equipment comply with all Contract requirements. A manufacturer's statement indicating complete compliance with the applicable Federal Specification, Military Specification, or Standard of the American Society for Testing and Materials or other commercial standard, will be acceptable as proof of such compliance.
- E. SLEEVES:
 - 1. Sleeves for Round Ductwork: galvanized steel.
 - 2. Sleeves for Rectangular Ductwork: galvanized steel.
- F. CAULK:

Caulk all sleeves water and airtight.
- G. ACCESSORIES:

Forged steel or malleable iron accessories, including steel bolts with nuts and washer, "U" bolts, Eyebolts, turnbuckles, rod couplings, rod sockets, straps and clamps.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. All equipment shall be installed so as to provide proper working space, access, bracing for Seismic Zone 4, and space for removal of the equipment as required by the various equipment items.

3.2 PAINTING:

Painting shall be in accordance with Section 09901, PAINTING. Maintain the original factory finish on material and equipment installed, unless specifically indicated on the plans or specifications. If the finish is marred in transit or during installation, re-finish to a neat, workmanlike appearance. Leave equipment clean and free of grease, dirt, rust, and in a suitable condition for painting.

3.3 CLEANING:

- A. Equipment and materials shall be cleaned after final installation.
- B. Remove all excess material and debris. Clean out all lines and fittings and adjust all dampers. Place mechanical system in complete working order before request for final review. All areas shall be left broom cleaned. Ductwork shall be thoroughly cleaned inside and out before grilles are installed.

3.4 PROTECTIVE REQUIREMENTS:

- A. Adequately protect work, equipment, fixtures, and materials. At work completion, all work must be clean and in good condition.

3.5 SEISMIC PROTECTION:

All mechanical equipment and systems shall be seismically braced in accordance with TI 809-04. Bracing and anchorage shall be sized for Seismic Zone 4, and details shall be in accordance with SMACNA and local requirements.

3.6 CLEAN AND ADJUST:

Remove shipping labels, dirt, paint, grease, and stains from equipment. Remove debris as it accumulates. Upon completion of work, clean equipment and the entire mechanical installation so that it is suitable for the Government's use.

END OF SECTION

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SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 15 Sections.
 - 1. Equipment nameplate data requirements.
 - 2. Field-fabricated metal equipment supports.
 - 3. Installation requirements common to equipment specification Sections.
 - 4. Mechanical demolition.
 - 5. Touchup painting and finishing.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, and spaces above ceilings.
- B. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions.
- D. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above suspended ceilings, in chase and in furred spaces.
- E. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Samples of color, lettering style, and other graphic representation required for each identification material and device.
- B. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- C. Shop drawings for access panel and door locations.
- D. Prepare design and shop drawings to a 1/4-inch scale. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the work. Provide all calculations. Include the following:
 - 1. Proposed locations of ductwork, equipment, and materials. Include the following:

- a. Planned equipment and duct systems layout, including elbow radii and duct accessories.
 - b. Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
 - c. Equipment service connections and support details.
 - d. Equipment schedules.
 - e. Controls
 - f. Details
2. Scheduling, sequencing, movement, and positioning of equipment and materials in the building during construction.
 3. Floor plans, elevations, and details to indicate penetrations in walls and their relationship to other penetrations and installations.
 4. Ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, and other ceiling-mounted items.
- E. Welder certificates signed by Contractor certifying that welders comply with requirements specified below.

1.4 QUALITY ASSURANCE

- A. Qualify welding processes and operators for structural steel according to AWS D1.1.
- B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions of ASME B31 Series.
 2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
- C. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide covered shelters for storage of all mechanical equipment. Cover all equipment with polyethylene covering.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work.
- D. Coordinate connection of electrical services.
- E. Provide access panels and doors where mechanical items requiring access are concealed behind finished surfaces.

- F. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces.

1.7 LAYOUT AND COORDINATION

- A. Be responsible for the correctness of measurements in connection with Work. Change made to major overall dimensions shown which affect the physical size, shape, or location of any part of the Work, whether due to field check or changes due to the use of equipment of a manufacturer other than that used as a basis of design shall cause no interference with other Work.
- B. Examine the Drawings of other trades, cooperate and coordinate with other trades to insure that the Work can be installed properly as designed and planned without interference with other work or delay. Where interferences may occur and departures from arrangements shown are required, consult with other trades involved. Come to an agreement as to changes, locations, and elevations. Furnish all necessary templates, patterns, measurements, etc., for installation and for the purpose of making adjoining work conform. Furnish plans and shop details to other trades as required.
- C. Investigate the structural and finish conditions affecting the Work. Offsets, bends or other items required may not be shown due to the small scale of the Drawings; provide such offsets, bends or other items as required to meet structural or finish condition.
- D. Coordinate and be responsible for the required clearances in shafts, chases, double partitions and suspended ceilings. Coordinate and cooperate with the trades responsible for constructing such spaces, together with other trades sharing such spaces, and advise other trades of the requirements of the Work. Immediately submit for review large scale composite Drawings showing space requirements that exceed those shown.
- E. Prepare large scale composite working drawings, 1/4 inch = 1'-0" minimum scale for all mechanical and electrical rooms; and including such section views and details as are necessary to clearly show how the systems are to be installed in relation to the work of other trades. Include double line ductwork, conduit, penetrations, and openings. Issue such Drawings to the other trades for coordination of their work. Finished Drawings shall be signed off by the Contractor and mechanical and electrical installers. Where such drawings show deviations from the Contract Drawings or conflict with other trades, detail and submit such deviation or conflicts to the COR for review.
- F. If work is installed before coordinating with other trades so as to cause interference with the work of other trades, or so as not to provide proper access for maintenance or repair, make necessary changes to correct the condition at no cost to the government.

PART 2 - PRODUCTS

2.1 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 15 Sections. Furnish signs, nameplates, tags and chart frames conforming to ANSI, OSHA and ISO Specifications and Standards.
 - 1. ANSI A13.1 for wording, colors, type and size of lettering required to identify pipes and conduits used for materials of inherently low hazard, and for inherently hazardous materials used for fire quenching.
 - 2. OSHA Safety Color Code for marking physical hazards.
 - 3. OSHA Specifications for accident prevention signs.
 - 4. ISO Standards for color, shape, symbols and surrounds.

- B. Signs: Standard and special signs may be embossed 1/8 inch thick laminated plastic of appropriate size, color, symbols and lettering with contrasting color core, or screen applied symbols and lettering on 1/8 inch thick plastic of appropriate size and color. Signs of Safety, Inc., and Best Mfg. Co., manufactures products that meet the requirements of this specification.
- C. HVAC System Markers: Fabricate markers indicating content, function, source, destination and direction of air flow of durable plastic.
- D. Equipment Nameplates: In general nameplates shall be engraved laminated plastic of appropriate size, lettering, and color. Nameplates for electrical equipment shall be phenolic material, black with white core, 1/16 inch thick with 1/32 inch beveled edges, 3/8 inch high lettering.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

- A. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the COR.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
- C. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.
- D. All equipment and materials shall be installed in accordance with manufacturer's instructions. The Contractor shall maintain a copy of the instructions at the job site and make a copy available to the RE prior to installing the equipment or material.

3.2 LABELING AND IDENTIFYING

- A. Equipment: Install engraved plastic laminate sign or equipment marker on or near each major item of mechanical equipment.
 - 1. Lettering Size: Minimum 1/4-inch-high lettering for name of unit where viewing distance is less than 2 feet, 1/2-inch -high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
- B. Duct Systems: Identify air supply with duct markers.
 - 1. Location: In each space where ducts are, locate signs near points where ducts enter into space and at maximum intervals of 50 feet.
- C. Adjusting: Relocate identifying devices which become visually blocked by work of this Division or other Divisions.

3.3 PAINTING AND FINISHING

- A. Refer to Section 09900 "Painting" for field painting requirements.

- B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment. Follow manufacturer recommendations for ceiling mounted equipment installation.
- B. Field Welding: Comply with AWS D1.1.

3.5 CUTTING AND PATCHING

- A. Cut walls, partitions, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

END OF SECTION 15050

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SECTION 15891 - METAL DUCTWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes rectangular and round metal ducts, and plenums for heating, ventilating, and air conditioning systems in pressure classes up to 3 inches water gage.

1.2 REFERENCE STANDARDS

- A. Air Movement and Control Association (AMCA)
- B. American Society of Heating, Refrigerating and Air Conditioning Engineers Inc. (ASHRAE).
 - 1. Handbook - HVAC Systems and Applications (Current Edition)
 - 2. Handbook - HVAC Fundamentals (Current Edition)
- C. American Society for Testing and Materials (ASTM).
 - 1. A36 - Carbon Structural Steel
 - 2. A366 - Standard for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
 - 3. A480 - General Requirements for Flat-Rolled, Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - 4. A527 - Standard for Steel Sheet, Zinc Coated by Hot Dipped Process.
 - 5. A700 - Standard practices for Packaging, Marketing, and Loading Methods for Steel Products for Domestic Shipment
 - 6. C411 - Test Method for Hot Surface Performance of High Temperatures Thermal Insulation.
 - 7. C920 - Elastomeric Joint Sealants.
 - 8. C1071 - Thermal and Acoustic Insulation
 - 9. E84 - Test Method for Surface Burning
- D. American Welding Society (AWS)
 - 1. D1.1 Structural Welding Code Steel
 - 2. D9.1 Sheet Metal Welding Code
- E. Federal Specifications (FS)
 - 1. TT-S-001657 - Sealing Compound Single Component Butyl Rubber Based, Solvent Release Type.

- F. National Fire Protection Association (NFPA)
 - 1. 90A - Installation of Air Conditioning and Ventilation Systems.
- G. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA)
 - 1. Duct Construction Standards.
- H. Underwriters Laboratories (UL)
 - 1. 181 - Standard for Safety Factory-Made Air Ducts and Air Connectors

1.3 DEFINITIONS

- A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:
 - 1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
 - 2. Joints: Joints include girth joints; branch and sub-branch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.4 SUBMITTALS

- A. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:
 - 1. Sealing Materials.
 - 2. Fire-Stopping Materials.
- B. Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:
 - 1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
 - 2. Duct layout, indicating pressure classifications and sizes in plan view.
 - 3. Fittings.
 - 4. Reinforcing details and spacing.
 - 5. Seam and joint construction details.
 - 6. Penetrations through fire-rated and other partitions.
 - 7. Terminal unit and coil installations.
 - 8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
- C. Shop drawings for ductwork installation in accordance with Section 15050 "Basic Mechanical Requirements." In addition to the requirements specified in "Basic Mechanical Requirements," show the following:

1. Spatial coordination with other systems installed in the same space with the duct systems.
 2. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.
- D. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in "Quality Assurance" below.
- E. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices.
- F. Maintenance data for volume control devices, fire dampers, and smoke dampers.

1.5 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 for hangers and supports and AWS D9.1.
- B. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.
- C. NFPA Compliance: Comply with the following NFPA Standards:
1. NFPA 90A

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Sheet Metal, General: Provide sheet metal in thickness indicated, packaged and marked as specified in ASTM A700.
- B. For rigidity and support, provide one gage heavier duct than SMACNA requires.
- C. Galvanized Sheet Steel: Lock-forming quality, ASTM A527, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.
- D. Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcing where installed on galvanized sheet metal ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8 - inch minimum diameter for lengths longer than 36 inches.

2.2 SEALING MATERIALS

- A. Joint and Seam Sealant, General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics. Seal all joints all around with mastic and mash. Sealing only the corners is not acceptable.
- B. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with the tape to form a hard, durable, airtight seal.
- C. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 75 percent solids.
- D. The duct sealing materials shall conform to SMACNA requirements.

2.3 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4 inches thick.
- B. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.
 - 1. Hangers Installed in Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot dipped-galvanized rods with threads painted after installation.
 - 2. Straps and Rod Sizes: Conform with Table 4-1 in SMACNA HVAC Duct Construction Standards, 1985 Edition, for sheet steel width and gage and steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A36.
 - 1. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.

2.4 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

- A. Round Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Duct Joints:
 - 1. Ducts up to **20 Inches** in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 - 2. Ducts **21 to 72 Inches** in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.

3. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
- C. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- D. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Construction shall comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible." Unless elbow construction type is indicated, fabricate elbows as follows:
 1. Round Elbows **9 through 14 Inches** in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 2. Round Elbows Larger Than **14 Inches** in Diameter: Fabricate gored elbows unless space restrictions require mitered elbows.
 3. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

- A. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.
- B. Install ducts with the fewest possible joints.
- C. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.
- D. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
- E. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment. New duct installation shall be located in the general location of the existing ductwork.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.
- J. Coordinate layout with lighting layouts and similar finished work.

- L. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and are exposed to view, conceal space between construction opening and duct with sheet metal flanges of same gage as duct. Overlap opening on all sides by at least 1-1/2 inches.
- M. Install dampers.

3.2 HANGING AND SUPPORTING

- A. Install rigid round duct with support systems indicated in SMACNA "HVAC Duct Construction Standards."
- B. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16 feet and at each floor.
- D. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.

3.3 CONNECTIONS

- A. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards."
- B. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards."
- C. Terminal Units Connections: Comply with SMACNA "HVAC Duct Construction Standards."

3.4 FIELD QUALITY CONTROL

- A. Contract with an independent testing agency to perform, record, and report leakage tests.
- B. Remake leaking joints as required and apply sealant to achieve specified maximum allowable leakage.
- C. Determine leakage from entire system or section of the system by relating leakage to the surface area of the test section.
- D. Maximum Allowable Leakage: As described in ASHRAE Handbook, "Fundamentals" Volume.
- E. Remake leaking joints as required and apply sealant to achieve specified maximum allowable leakage.
- F. Leakage Test: Perform volumetric measurements and adjust air systems as described in ASHRAE "HVAC Systems and Applications" Volume, ASHRAE "Fundamentals" Volume, and Section 15990, "TESTING, ADJUSTING, AND BALANCING."

3.5 ADJUSTING AND CLEANING

- A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Section 15990, "TESTING, ADJUSTING, AND BALANCING" for requirements and procedures for adjusting and balancing air systems.
- B. Vacuum ducts systems prior to final acceptance to remove dust and debris.

END OF SECTION 15891

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SECTION 15910 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Manual volume control dampers.
 - 2. Duct-mounted access doors and panels.
 - 3. Accessories hardware.

1.2 REFERENCE STANDARDS

- A. National Fire Protection Association (NFPA)
 - 1. 90A - Standard for Installation of Air Conditioning and Ventilating Systems.
 - 2. 90B - Standard for Installation of Warm Air Heating and Air Conditioning Systems.
- B. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
 - 1. HVAC Duct Standard
- C. Underwriters Laboratories (UL)
 - 1. 181 - Factory Made Air Ducts and Air Connectors

1.3 SUBMITTALS

- A. Product data including details for materials, dimensions of individual components, profiles, and finishes for the following items:
 - 1. Manual volume control dampers.
 - 2. Duct-mounted access panels and doors.
- B. Shop drawings from manufacturer detailing assemblies. Include dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail the following:
 - 1. Special fittings and volume control damper installation details.
 - 2. Duct-mounted access door and panel installations.
- C. Product Certification: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static pressure loss, and dimensions and weights.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Comply with the following NFPA Standards:

1. NFPA 90A
2. NFPA 90B

PART 2 - PRODUCTS

2.1 MANUAL VOLUME CONTROL DAMPERS

- A. General: Provide factory-fabricated volume-control dampers, complete with required hardware and accessories. Stiffen damper blades to provide stability under operating conditions. Provide locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class. Provide end bearings or other seals for ducts with pressure classifications of **3 inches** or higher. Extend axles full length of damper blades. Provide bearings at both ends of operating shaft.
- B. Volume Control Dampers: Butterfly type consisting of circular blade mounted to a shaft.
 - 1. Steel Frames: 20 gage galvanized steel up to 24" diameter, 7" long. Provide flangeless frames where indicated for installation in ducts.
 - 2. Roll-Formed Steel Blades: Blade shall be constructed of two layers of galvanized steel, 14 gage equivalent thickness.
 - 3. Blade Axles: Galvanized steel.
- C. Axle: **1/2-inch**-diameter.
- D. Damper Control Hardware: Hand quadrants, Ruskin Model HQR050, or approved equal.
- E. Known acceptable source: Ruskin, Model CDRS25, or approved equal.

2.2 DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. General: Provide construction and airtightness suitable for duct pressure class.
- B. Provide access door at volume dampers.
- C. Frame: Galvanized sheet steel. Provide with bend-over tabs and foam gaskets.
- D. Door: Double-wall, galvanized sheet metal construction with insulation fill and thickness. Provide **1-inch by 1-inch** butt hinge or piano hinge and cam latches.
- E. Seal around frame attachment to duct and door to frame with neoprene or foam rubber seals.

- F. Insulation: 1-inch- thick fiber glass or polystyrene foam board.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of duct accessories. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install duct accessories according to manufacturer's installation instructions and applicable portions of details of construction as shown in SMACNA standards.

3.3 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Final positioning of manual dampers is specified in Section 15990, "Testing, Adjusting, and Balancing."

END OF SECTION 15910

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SECTION 15932 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Types of outlets required for project include the following:
 - 1. Construct the supply air plenums, as indicated on the drawings, consisting of shop fabricated supply plenum and wall grilles.

1.2 REFERENCE STANDARDS

- A. Air Diffusion Council (ADC)
 - 1. 1062 - Certification, Rating and Test Manual
- B. Air Movement and Control Association (AMCA)
 - 1. 500 - Test Method for Louvers, Dampers, and Shutters.
- C. Air-Conditioning and Refrigeration Institute (ARI)
 - 1. 650 - Standard for Air Outlets and Inlets
- D. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
 - 1. 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- E. American Society for Testing and Materials (ASTM)
 - 1. B221 - Standard for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
- F. National Fire Protection Agency (NFPA)
 - 1. 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Provide Air Outlets manufactured in accordance with the following standards and ratings:

1. Tested and rated in accordance with ARI 650.
2. Tested and rated in accordance with ASHRAE 70.
3. Tested and rated in certified laboratories under requirements of ADC 1062.
4. Inlets and outlets shall bear the ADC Certified Rating Seal.
5. Tested and rated louvers in accordance with AMCA 500.
6. Louvers shall bear AMCA Certified Rating Seal.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data for air outlets including the following:
 1. Schedule of air outlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
 2. Data sheet for each type of air outlet and accessory furnished; indicating construction, finish, and mounting details.
 3. Performance data for each type of air outlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of supply air plenum, air outlet, indicating materials and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver air outlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- B. Store air outlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors in a waterproof area, store above grade and enclose with waterproof wrapping.

1.6 MAINTENANCE

- A. Spare Parts: Furnish to the Government, with receipt, 3 operating keys for each type of air outlet that require them.

PART 2 - PRODUCTS

2.1 GRILLES: SUPPLY AIR

- A. General: Except as otherwise indicated, provide manufacturer's standard wall grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

- B. Performance: Provide grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.
- C. Compatibility: Provide grilles with border styles that are compatible with supply air plenum assembly, and that will fit into the supply air plenum construction with accurate fit and adequate support. Refer to general construction drawings and specifications.
- D. Types: Provide wall grilles of type, capacity, and with accessories and finishes as shown on the drawings. The following requirements shall apply to nomenclature indicated on schedule:
 - 1. Grille Materials:
 - a. Aluminum Construction (AL): Manufacturer's standard extruded aluminum frame and adjustable blades.
 - 2. Grille Faces:
 - a. Horizontal Straight Blades (H-S): Horizontal blades, individually adjustable, at manufacturer's standard spacing.
 - b. Vertically Straight Blades (V-S): Vertical blades, individually adjustable, at manufacturer's standard spacing.
 - 3. Grille Patterns:
 - a. Double Deflection (D-D): 2-sets of blades in face, rear set at 90 degrees to face set.
 - 4. Finishes:
 - a. Paint plenum and all grille surfaces with semi-gloss enamel to match color of existing supply plenums.
- E. Known Acceptable Source:
 - 1. Metal-Aire, Metal Industries, Inc.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which air outlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. General: Install air outlets in accordance with manufacturer's written instructions, in accordance with recognized industry practices, and in accordance with NFPA 90A to insure that products serve intended function.
- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets with other work.

END OF SECTION 15932

SECTION 15933 - AIR TERMINALS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Types of air terminals specified in this section include the following:
 - 1. Single Duct Variable Air Volume (VAV) Boxes
 - a. Electric Reheat
- B. Refer to Division-16 sections for the following work; not work of this section.
 - 1. Power supply wiring from power source to power connection on air terminals. Include starters, disconnects, and required electrical devices, except where specified as furnished or factory-installed, by manufacturer.
- C. Provide the following electrical work as work of this section, complying with requirements of Division 16 sections:
 - 1. Control Wiring between field-installed controls and air terminals.

1.2 REFERENCE STANDARDS

- A. Air Diffusion Council (ADC)
- B. Air Conditioning and Refrigeration Institute (ARI)
 - 1. 880 - Industry Standard for Air Terminals
- C. National Fire Protection Association (NFPA)
 - 1. 90A - Air Conditioning and Ventilating System
- D. Underwriters Laboratories (UL)

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturing of air terminals with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Provide Air Terminals manufactured in accordance with the following standards and ratings:
 - 1. Tested and rated in accordance with ADC standards, and bear ADC Seal.
 - 2. Tested and rated in accordance with ARI 880 and bear ARI certification seal.
 - 3. Acoustical and thermal insulations complying with NFPA 90A.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including performance data for each size and type of air terminal furnished; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished; and installation and start-up instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- C. Wiring Diagrams: Submit ladder-type wiring diagrams for electric power and control components, clearly indicating required field electrical connections.
- D. Maintenance Data: Submit maintenance data and parts list for each type of air terminal; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and maintenance data in maintenance manual.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver air terminals wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of air terminal and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in boxes.
- B. Provide covered storage. Store air terminals in original cartons and protect from weather and construction work traffic. Cover items with polyethylene waterproof wrapping.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Known Acceptable Source:
 - 1. Nailor Industries, Inc.

2.2 AIR TERMINALS:

- A. General: Provide factory-fabricated and tested air terminals as indicated, selected with performance characteristics which match or exceed those indicated on schedule. The unit shall include all equipment and controls as required to provide a complete and operating system.
- B. Casings: Construct of die-cast aluminum or sheet metal of the following minimum thicknesses:

	<u>Steel</u>	<u>Aluminum</u>
Upstream Pressure Side:	24-ga	0.032 inch
Downstream Pressure Side:	26-ga	0.025 inch

- 1. Provide hanger brackets for attachment of supports.
- 2. Linings: Line inside surfaces of casings with lining material to provide acoustic performance, thermal insulation, and to prevent condensation on outside surfaces of casing. Provide minimum thickness of $\frac{3}{4}$ inch. Secure lining to prevent delamination, sagging, or settling.

- a. Cover liner surfaces and edges with coating or perforated metal.
- 3. Access: Provide removable panels in casings to permit access to air dampers and other parts requiring service, adjusting, or maintenance.
 - a. Provide airtight gasket and quarter-turn latches.
- 4. Leakage: Construct casings such that when subjected to 0.5 inch w.g. pressure for low pressure units, and 3.0 inches w.g. pressure for high pressure units, total leakage does not exceed 4% of specified air flow capacity with outlets sealed and inlets wide open. Construct air dampers such that when subjected to 6.0 inches w.g. inlet pressure with damper closed, total leakage does not exceed 10% of specified air flow capacity.
- C. Air Dampers: Construct dampers of materials that cannot corrode, do not require lubrication, nor require periodic servicing. Provide volume dampers that are calibrated in cfm, factory-adjusted, and marked for specified air capacities. Provide mechanism to vary air volume thru damper for minimum to maximum, in response from signal from thermostat.
- D. Controls: VAV units shall be equipped with pressure independent direct digital controls supplied by the control contractor under Specification Section 15970 HVAC Controls and mounted by VAV unit manufacturer. The control contractor shall, in addition to sending the controls to the terminal unit manufacturer, provide technical data, mounting hardware and method, as well as application specific wiring diagrams for each VAV. VAV unit installation shall be compatible with the existing SCT ECMS system.
- E. Identification: Provide label on each unit indicating Plan Number, cfm range, cfm factory-setting, and calibration curve (if required).
- F. Variable Air Volume (VAV) Boxes: All VAV boxes, with electric heaters, shall be factory wired and tested for proper operation prior to delivery to site. Include certified report with equipment delivered. Provide the following features and accessories:
 - 1. Electric Heating Coils: Provide heating coils constructed of electric resistance elements in galvanized steel casing with control box and factory-wiring. Provide over-temperature protection and UL-listing as duct heater. Electric heating coils shall be designed for operation with the DDC control system.
 - 2. Remote Diffuser Air Outlets: Extruded aluminum or sheet steel with baked-enamel finish, suitable for ceiling system.
 - 3. Hardware: Provide hardware as required to complete ceiling system including unit mounting brackets, trim pieces, alignment channels, etc.
 - 4. Door interlocking disconnect switch for electric heater control box.
 - 5. Individual overcurrent protection devices for units and transformers.
 - 6. Flow sensors and flow control devices.
 - 7. Transformer with 24VAC to provide power for units controls.
 - 8. Thermostat connection with thermostat to operate per control sequence provided on drawings.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which air terminals are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF AIR TERMINALS:

- A. General: Install air terminals as indicated, and in accordance with manufacturer's installation instructions.
- B. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.
- C. Duct Connections: Connect ductwork to air terminals in accordance with Section 15891, "Metal Ductwork," and Section 15932, "Air Outlets and Inlets."

3.3 FIELD QUALITY CONTROL:

- A. Upon completion of installation and prior to initial operation, test and demonstrate that air terminals, and duct connections to air terminals, are leak-tight.
- B. Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.
- C. Test and demonstrate controls for each air terminal. Verify that controls operate as specified.

3.4 CLEANING:

- A. Clean exposed factory-finished surfaces. Repair any marred or scratched surfaces with manufacturers touch-up paint.

3.5 IDENTIFICATION

- A. Provide identification and tags as required in section 15050, "Basic Mechanical Materials and Methods."

END OF SECTION 15933

SECTION 15970 - HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes control equipment for the VAV units and components, including control components for terminal electric heating supplied with factory-wired controls. The new equipment shall be controlled via the existing ECMS system (which was manufactured by Teletrol and installed by Pacific Rim Mechanical).

1.3 DEFINITIONS

- A. DDC: Direct-digital controls.

1.4 SYSTEM DESCRIPTION

- A. Control system consists of sensors, actuators, final control elements, interface equipment, other apparatus, and accessories necessary to control mechanical systems.

1.5 SEQUENCE OF OPERATION

- A. Variable Air Volume Box (VAV-78) with Electric Reheat

On a rise in space temperature, the damper/actuator is modulated to increase the airflow. At 2° F above the cooling set point, the maximum airflow is maintained at a preselected setting. On a decrease in space temperature, the damper/actuator is modulated to decrease the airflow until the room temperature reaches the cooling set point, at which the minimum airflow is maintained. Minimum airflow is maintained until the room temperature drops to the heating set point. When the room temperature drops to the heating set point, and below, the thermostat heating mode is initiated, which causes the electric reheat to be energized, and the damper/actuator is modulated to the preset auxiliary airflow flow limit. During unoccupied hours, set point of thermostat is changed automatically to maintain night setback temperatures.

- B. Variable Air Volume Box (VAV-79)

On a rise in space temperature, the damper/actuator is modulated to increase the airflow. At 2° F above the cooling set point, the maximum airflow is maintained at a preselected setting. On a decrease in space temperature, the damper/actuator is modulated to decrease the airflow until

the room temperature reaches minimum cooling set point, at which the minimum airflow is maintained.

FUNCTION	VAV-78	VAV-79
Space Temperature Control	X	X
Space Temperature Indication	X	X
Start-Stop	X	X
Damper Modulation	X	X
Electric Heating	X	
Discharge Air Temperature Sensing	X	X
Discharge Air Temperature Control (Heating)	X	
Air Flow Indication	X	X

1.6 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 1. Each control device labeled with setting or adjustable range of control.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 1. Schematic flow diagrams showing dampers, actuators, and control devices.
 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 3. Details of control panel faces, including controls, instruments, and labeling.
 4. Written description of sequence of operation.
 5. Schedule of dampers including size, leakage, and flow characteristics.
 6. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
 7. Listing of connected data points, including connected control unit and input device.
 8. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
 9. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- D. Maintenance Data: For systems to include in maintenance manuals specified in Division 1. Include the following:
 1. Maintenance instructions and lists of spare parts for each type of control device.

2. Interconnection wiring diagrams with identified and numbered system components and devices.
 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 5. Calibration records and list of set points.
- E. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- E. Comply with ASHRAE 135 for DDC system control components.
- F. Year-2000 Compliant: Computer hardware and software shall be capable of accurately processing, providing, and receiving date data from, into, and between the twentieth and twenty-first centuries, including leap-year calculations.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.9 COORDINATION

- A. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance and compatibility with the existing system in the SCT, the control system components shall be manufactured by Teletrol Systems Inc.

2.2 THERMOSTATS

- A. Electric solid-state, microcomputer-based room thermostat with remote sensor.
 - 1. Automatic switching from heating to cooling.
 - 2. Preferential rate control to minimize overshoot and deviation from set point.
 - 3. Set up for four separate temperatures per day.
 - 4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
 - 5. Programming based on every day of the week.
 - 6. Selection features include: fan on-auto.
 - 7. Battery replacement without program loss.
 - 8. Thermostat display features include the following:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System mode indications include "heating," "off," "fan auto," and "fan on."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Verify that duct- and equipment-mounted devices and wiring are installed before proceeding with installation.

3.2 INSTALLATION

- A. Install equipment level and plumb.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats and other exposed control sensors with plans and room details before installation.
- D. Install guards on thermostats in the following locations:
 - 1. Entrances.
 - 2. Public areas.
 - 3. Where indicated.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. All required electrical work shall be provided in accordance with Division 16 requirements.

3.4 CONNECTIONS

- A. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Replace damaged or malfunctioning controls and equipment.
 - 1. Start, test, and adjust control systems.
 - 2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
 - 3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules for newly installed equipment.
 - 2. Review data in maintenance manuals.

END OF SECTION 15900

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SECTION 15990 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY:

- A. This Section specifies the requirements and procedures total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
- B. Test, adjust, and balance the following mechanical systems:
 - 1. Supply air systems, all pressure ranges; including variable volume;
 - 2. Verify temperature control system operation.
- C. Test systems for proper sound and vibration levels.
- D. This section includes testing, adjusting, and balancing of airflow in the new supply duct section and temperature controls for VAV-78 and VAV-79. The existing system (AH-17 to AH-22) for the second floor is designed for four air handlers to operate at any one time, with two additional air handlers on standby.

1.2 DEFINITIONS:

- A. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:
 - 1. The balance of air and water distribution;
 - 2. Adjustment of total system to provide design quantities;
 - 3. Electrical measurement;
 - 4. Verification of performance of all equipment and automatic controls;
 - 5. Sound and vibration measurement.
- B. Test: To determine quantitative performance of equipment.
- C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).
- D. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.
- E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.
- F. Report forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

- G. Terminal: The point where the controlled fluid enters or leaves the distribution system. These are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
- H. Main: Duct or pipe containing the system's major or entire fluid flow.
- I. Submain: Duct or pipe containing part of the systems' capacity and serving two or more branch mains.
- J. Branch main: Duct or pipe serving two or more terminals.
- K. Branch: Duct or pipe serving a single terminal.

1.3 SUBMITTALS:

- A. Agency Data:
 - 1. Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.
- B. Engineer and Technicians Data:
 - 1. Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
- C. Procedures and Agenda: Submit a synopsis of the testing, adjusting, and balancing procedures and agenda proposed to be used for this project.
- D. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this information in maintenance data specified in Division 1 and Section 15010.
- E. Sample Forms: Submit sample forms, if other than those standard forms prepared by the AABC or NEBB are proposed.
- F. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:
 - 1. Draft reports: Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
 - 2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports.
 - 3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind

report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:

- a. General Information and Summary
- b. Air Systems
- d. Temperature Control Systems
- f. Sound and Vibration Systems

4. Report Contents: Provide the following minimum information, forms and data:

- a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Government, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentation used for the procedures along with the proof of calibration.
- b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC or NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.

G. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.4 QUALITY ASSURANCE:

A. Test and Balance Engineer's Qualifications: A Professional Engineer (either on the installer's staff or and independent consultant), registered in the State in which the services are to be performed, and having at least 3-years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.

B. Agency Qualifications:

- 1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
- 2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) or by Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB as a Test and Balance Engineer.

C. Codes and Standards:

- 1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- 2. AABC: "National Standards For Total System Balance".

3. ASHRAE: ASHRAE Handbook, 1984 Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.
 - D. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with the COR and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.
- 1.5 PROJECT CONDITIONS:
- A. Systems Operation: Systems shall be fully operational prior to beginning procedures.
- 1.6 SEQUENCING AND SCHEDULING:
- A. Test, adjust, and balance the air systems.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING:

- A. Before operating the system, perform these steps:
 1. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.
 2. Obtain copies of approved shop drawings of all air handling equipment, outlets, and temperature control diagrams.
 3. Compare design to installed equipment and field installations.
 4. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.
 5. Check filters for cleanliness.
 6. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation.
 7. Prepare report test sheets for outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes.
 8. Determine best locations in main and branch ductwork for most accurate duct traverses.
 9. Place outlet dampers in the full open position.
 10. Prepare schematic diagrams of system "as-built" ductwork layouts to facilitate reporting.

3.3 MEASUREMENTS:

- A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.
- B. Provide instruments meeting the specifications of the referenced standards.

- C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.
- D. Apply instrument as recommended by the manufacturer.
- E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.
- F. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.
- G. Take all reading with the eye at the level of the indicated value to prevent parallax.
- H. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.
- I. Take measurements in the system where best suited to the task.

3.4 PERFORMING TESTING, ADJUSTING, AND BALANCING:

- A. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.
- B. Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
- C. Patch insulation, ductwork, and housings, using materials identical to those removed.
- D. Seal ducts and test for and repair leaks.
- E. Seal insulation to re-establish integrity of the vapor barrier.
- F. Mark equipment settings, including damper control positions and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.
- G. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.
- H. Air Balancing and Documentation: Volume dampers on each branch supply duct shall be adjusted so that at least one volume damper on that branch duct is wide open and each diffuser is furnishing the specified airflow rate to within plus or minus 5% of the specified values. This will minimize the pressure drop across the final volume damper and limit transmitted noise. Setting of dampers and other volume adjustment devices shall be permanently marked so they can be restored if disturbed at any time. All air measurement readings taken during the adjustment work shall be recorded and two (2) copies of resulting data shall be furnished to the Resident Engineer for approval.

3.6 RECORD AND REPORT DATA:

- A. Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by the referenced standards, and as approved on the sample report forms.

- B. Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.
- C. Furnish a typewritten report documenting air balance test data which shall include the following:
 - 1. System Number
 - 2. Area Served
 - 3. Date of Test
 - 4. Name of Individual Certifying Test
 - 5. Design Air Quantities (CFM) - (Show at each air handling unit's supply, return and outside duct connections and at diffusers, grilles, and registers).
 - 6. Actual Air Quantities (CFM) - (Same as 5.)
 - 7. Actual Air S.P. (inches W.G.) - (Show pressure relative to atmosphere at blower inlet and outlet, at upstream and downstream side of filters, at upstream and downstream side of cooling and/or heating coils, and at return air duct connection and at supply air duct connection of air conditioning unit or air handling unit cabinet.)
 - 8. Air Temperature Entering Cooling/Heating Apparatus.
 - 9. Air Temperature Leaving Cooling/Heating Apparatus.

END OF SECTION 15990

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. General:

1. The general electrical requirements in this section are applicable to both GFE and non-GFE equipment.
2. Materials and equipment shall comply with all requirements of the contract documents. Materials furnished by the contractor shall be new, the standard products of manufacturers regularly engaged in the production of such materials, and of the manufacturer's latest designs that comply with the specification requirements. If material and equipment requirements conflict, the order of precedence for selection shall be as follows: special contract provision, the contract drawings, this specification; and then in continuing order of precedence, Military Specifications, Federal Specifications, NFPA publications, IEEE standards, UL standards and NEMA standards. Wherever standards have been established by Underwriters' Laboratories, Inc., the material shall bear the UL label.

B. Provide the following electrical equipment and systems:

1. Equipment, wiring devices, and electrical connections required for installation of electrical equipment.
2. Indoor, normal and emergency lighting system.
3. Raceways and wiring for power and controls.
4. Grounding systems.

C. Minor departures from exact dimensions shown in electrical plans may be permitted when required to avoid conflict or unnecessary difficulty in placement of a dimensioned item, provided all contract requirements are met. The Contractor shall promptly obtain approval from the COR prior to undertaking any such departures, and shall provide appropriate documentation of the departure.

1.2 REFERENCE STANDARDS

A. General: Comply with the standards in effect as of the date of the Contract Documents as applicable to the extent specified in Division 16. The rules, regulations and reference specifications enumerated in these specifications shall be considered as minimum requirements. Adherence to other standards shall not relieve the contractor from furnishing and installing higher grades of materials and workmanship when so required by this specification. Adherence to this specification shall not relieve the Contractor from furnishing and installing higher grades of materials and workmanship when so required by the contract Drawings or special contracts provisions.

B. American Standard for Testing and Materials (ASTM)

1. D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

C. Federal Aviation Administration (FAA)

1. STD-019D - Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities.
2. STD-020B - Transient Protection, Grounding, Bonding and Shielding Requirements for Electronic Equipment.
3. FAA-C-1217F - Electrical Work, Interior.
4. FAA-C-1391B - Installation and Splicing of Underground Cables.

D. Institute of Electrical and Electronic Engineers (IEEE)

1. 519 - Recommended Practices and Requirements for Harmonic Control and Electrical Power Systems

E. National Electrical Manufacturers Association (NEMA)

1. WC5 - Thermoplastic Insulated Wire and Cable for Transmission and Distribution of Electrical Energy.
2. WC7 - Cross Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

F. National Fire Protection Association (NFPA)

1. 70 – 2002 National Electrical Code (NEC)

G. National Electrical Contractors Association (NECA)

1. Standard of Installation

H. Occupational Safety and Health Administration (OSHA)

1. 29 CFR 1910.7 - Description and Requirements for a Nationally Recognized Testing Laboratory (NRTL).

I. Underwriters Laboratories (UL)

1. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.

1.3 SUBMITTALS

- A. Contractor Provided Electrical Equipment Reference Material: The Contractor shall provide three copies of operating and maintenance instructions, equipment service manuals, catalog cuts and illustration as described in this section. The Operations and Maintenance (O&M) data shall be placed in suitable binders for use by maintenance personnel. The material shall include equipment model and serial numbers, performance characteristics, power and utility requirements, and manufacturer's recommended maintenance schedules. Final acceptance of this equipment is contingent upon submission of required documents to, and approval by, the COR prior to facility turnover.

1. Minimum data required.- Operating and maintenance instructions shall contain the following minimum data and shall comply with submittal requirements specified in individual Division 16 Sections.

- a. Operating instructions shall include illustrations and explanations for controls, initial set points, and startup and shutdown procedures for both normal and emergency conditions.
 - b. Maintenance instructions shall include periodic inspection and lubrication requirements, and where applicable, equipment performance verification requirements.
 - c. Troubleshooting and fault diagnosis data shall list trouble symptoms, instructions necessary to determine cause of trouble and the action required to restore equipment to operating condition.
 2. Repair instructions shall include equipment disassembly, repair, replacement, and re-assembly. Checkout or test data shall also be provided. Reprogramming instructions shall be provided for equipment having a programmable memory. Re-packing instructions shall be provided for sending equipment to the manufacturer or to a repair depot for repairs.
 3. A parts list shall be furnished that includes part names and part numbers that are shown on illustrations or tables. The parts list shall identify the actual manufacturer of the part, replacement cost, and shall also contain a notation of identifying products as Commercial grade for common non-special design hardware.
 4. The instructions shall contain a list of spare parts recommended by the equipment manufacturer to support the operation of the equipment for a one year time period.
- B. Project Record Documents: Maintain at the job site a separate set of white prints of the Contract Documents for the purpose of recording the system and dimension changes of those portions of work in which actual construction is significantly at variance with the Contract Documents. The Contractor shall record changes for both GFCI and Contractor provided equipment. Upon acceptance of the project, submit documents to the COR, with verification of data accuracy. Mark the Drawings with colored pencil. Prepare the Drawings as the work progresses. Upon completion of work submit Drawings clearly indicating the following:
1. Locations of devices, conduits, equipment and other pertinent items; Indicate the depth of buried ducts and direct burial cables;
 2. Schematic and interconnection wiring diagrams of the completed power and control system incorporating the data derived from the equipment shop drawings, and the cable and conduit schedule. The drawings shall be detailed to wire and terminal block numbers, conductor color coding, device designations, locations, and reflect identifications established at the site; and;
 3. Cable and conduit schedule for cables and conduits actually installed; include the type, size, origin, destination, and approximate length for each cable and conduit. Indicate for each cable the voltage rating, number of conductors, cable number, color coding, and routing.
- C. Samples: When the adequacy, quality, and safety of a material will be better demonstrated and it will expedite approval, provide single samples of items proposed for use. Conform to the procedures specified.
- D. Submit a summary of the Electrical Test Report on cables.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70 for components and installation. In case of conflict between provisions of codes, laws and ordinances, the more stringent requirement shall apply.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: NRTL as defined in OSHA Regulation 1910.7.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Contractor Provided Equipment: Equipment shall be protected from damage and stored in a dry location from the time of site delivery. Energize space heaters or provide desiccant recommended by the equipment manufacturer to prevent condensation. Conduct routine inspections of stored equipment to check equipment condition.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate electrical equipment installation with other building components. Coordinate electrical service installation with electrical utility.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations.
- C. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning prior to closing in the building.
- E. Coordinate connecting electrical service to components furnished under other Sections.
- F. Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.
- G. Coordinate installing electrical identifying devices and markings prior to installing acoustical ceilings and similar finishes that conceal such items.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

- A. Channel and Angle Supports, Raceway Supports, Sleeves, and Fasteners: As specified in Section 16190, "Supporting Devices."
- B. All supporting devices shall be designed and installed to meet the UBC Seismic requirements.

2.2 CONCRETE EQUIPMENT BASES

- A. Concrete: 3000-psi, 28-day compressive strength.

2.3 ELECTRICAL IDENTIFICATION

- A. General: Provide electrical Identification as specified in Section 16195, "Electrical Identification."
- B. Manufacturer's Standard Products: Use colors prescribed by ANSI A13.1, NFPA 70.

2.4 SOIL MATERIALS

- A. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural crushed sand.
- B. Backfill and Fill Materials: Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP; free of clay, rock, or gravel larger than 2 inches in any dimension; debris; waste; frozen materials; and vegetable and other deleterious matter.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION REQUIREMENTS

- A. All materials and equipment shall be installed in accordance with the Contract Drawings.
- B. Where manufacturers recommended installation methods conflict with contract requirements, difference shall be resolved by the COR
- C. The installation shall be accomplished by skilled workers regularly engaged in this type of work. Where required by local regulation, the workers shall be properly licensed.
- D. Install components and equipment to provide the maximum possible headroom where mounting heights or other location criteria are not indicated.
- E. Install items level, plumb, and parallel and perpendicular to other building systems and components, except where otherwise indicated.
- F. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- G. Give right of way to raceways and piping systems installed at a required slop.

3.2 INSTALLATION

- A. Contract Drawings: Where the Electrical and Communications Drawings schematically indicate the work, diagrammatically or otherwise, furnish and install equipment, material, and labor for a complete and proper installation. Ensure that electrical and communications Work is coordinated and compatible with Architectural, Mechanical and Structural Work.

- B. Fastening: Unless otherwise indicated, securely fasten electrical items and their supporting hardware to the building structure in accordance with Section 16190, "Supporting Devices."
- C. Install identification devices where required in accordance with the requirements of Section 16195, "Electrical Identification." Engrave nameplates as indicated up to a maximum of three lines. Identification and name plates shall be in accordance with FAA C-1217F, paragraphs 4.16 and 4.16.1.
- D. Wiring Methods.
 - 1. General: All wiring shall consist of insulated copper conductors installed in metallic raceways, unless otherwise specified.
 - 2. Conductor routing: Panelboards, surge arresters, disconnect switches, etc., shall not be used as raceway for conductor routing other than conductors that originate or terminate in these enclosures. Isolated ground conductors will be allowed to traverse these enclosures.
 - 3. Conductor separation: Power conductors shall be routed separately from all other conductor types. Route power conductors and other conductors in separate raceways, or by a metallic divider between the power conductors and the other conductors in the same raceway.
 - a. Power cables of less than 600 volts may be installed in the same duct.
 - b. Power cables of less than 600 volts shall not be installed in the same duct with control, telephone, or signal type cables.
 - 4. Neutral conductor: Shared/common neutrals shall not be permitted, i.e., each overcurrent device shall have its own separate neutral conductor. Neutral conductor sizes shall not be less than the respective feeder or phase conductor sizes.
 - 5. Ground conductor: Share/common neutrals shall not be permitted, i.e., each overcurrent device shall have its own separate ground conductor, i.e. a single-pole single phase overcurrent device shall be supplied with an equipment grounding conductor, a two-pole, single-phase overcurrent device shall be supplied with its own equipment grounding conductor. The equipment grounding conductor shall be installed in the same conduit as its' related branch and feeder conductors and shall be connected to the ground bus in the distribution panelboard.

3.3 DEMOLITION

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality functionaity.
- B. Accessible Work: Remove exposed electrical equipment and installtions, indicated to be demolished, in their entirety.
- C. Abandon Work: Cut and remove buried raceway and wiring indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- D. Remove demolished material from Project site.
- E. Remove, store, clean, reinstall, reconnect and make operational components indicated for relocation.

3.4 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair disturbed surfaces to match adjacent undisturbed surfaces

3.5 TESTING

- A. General: Unless otherwise indicated, the contractor shall furnish all test instruments, materials and labor necessary to perform tests designated in Division 16 Sections. All tests shall be performed in the presence of the COR. All instruments shall have been calibrated within a period of two years preceding testing. Calibrations shall be traceable to applicable industry recognized standards.
- B. An interim operating and performance test shall be performed for each major equipment item after installation is complete and before the item is placed in service. After mechanical systems have been completely installed and balanced, test each system for proper operation. Tests shall be conducted in the presence of the COR under design conditions to ensure proper sequence and operation throughout the range of operation. Make adjustments as required to ensure proper functioning of the systems. Special tests on individual systems are specified under individual sections. Provide 21 days written notice to the COR for major tests. Contractor shall demonstrate, to the COR's satisfaction, proper operation of control devices by simulating actual operating conditions. Devices tested shall include, but not be limited to, flow and pressure controls, temperature controls, and system interlocks and alarms.
- C. After final tests and adjustments have been completed, fully instruct the COR and other personnel as directed by the COR in details of operation and maintenance of electrical equipment, including control systems and fire alarm system as installed.
- D. Perform the tests specified and other tests necessary to establish the adequacy, quality, safety, completed status, and suitable operation of each system. Repair or replace equipment that does not meet test requirements and retest. Notify the COR in writing 21 days prior to conducting tests.
- E. Load Balancing.- After the tests of electrical systems have been completed, redistribute the loads where there is a greater than a twenty percent difference between readings in two or more phases, in accordance with Section 16470, "Panelboards."

END OF SECTION 16050

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SECTION 16100 - RACEWAYS, BOXES AND CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Raceways include the following:
 - 1. PVC coated rigid steel.
 - 2. Rigid metal conduit,-zinc coated (RGS).
 - 3. Intermediate metal conduit (IMC).
 - 4. Electrical metallic tubing (EMT).
 - 5. Flexible metal conduit.
 - 6. Liquidtight flexible conduit.
 - 7. Wireway.
- C. Boxes, enclosures, and cabinets include the following:
 - 1. Device boxes.
 - 2. Outlet boxes.
 - 3. Pull and junction boxes.
 - 4. Cabinets and hinged cover enclosures.

1.2 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. C80.1 Rigid Steel Conduit, Zinc-Coated RGS.
 - 2. C80.3 Electrical Metallic Tubing, Zinc-Coated (EMT).
 - 3. C80.6 Intermediate Metal Conduit (IMC) Zinc-Coated
- B. Federal Aviation Administration (FAA)
 - 1. STD- 019d Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities.
 - 2. STD-020b Transient Protection, Grounding and Shielding Requirements for Electronic Equipment.
 - 3. FAA-C-1217f Electrical Work, Interior.
- C. Federal Specifications (FS)
 - 1. W-C-586 Conduit Outlet Boxes, Bodies, and Entrance Caps.
- D. National Electrical Contractors Association (NECA)

E. National Electrical Manufacturers Association (NEMA)

1. FB1 Fitting, Cast Metal Boxes, and Conduit Bodies, and Cable Assemblies
2. OS1 Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
3. TC2 Electrical Plastic Tubing and Conduit
4. 250 Enclosures for Electrical Equipment (1000 Volts and Below)
5. ICS-6 Industrial Control System Enclosure.
6. RN1 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit.

F. National Fire Protection Association (NFPA)

1. 70 National Electrical Code (NEC)

G. Occupational Safety and Health Administration (OSHA)

1. 29 CFR 1910.7 - Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL).

H. Underwriters Laboratories (UL). Materials having UL listings shall bear the UL label:

1. 1 Flexible Metal Conduit
2. 6 Rigid Metal Conduit
3. 50 Enclosures for Electrical Equipment
4. 360 Liquid-tight Flexible Metal Conduit
5. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
6. 514A Metallic Outlet Boxes
7. 514 B Fittings for Conduit and Outlet Boxes
8. 797 Electric Metallic Tubing
9. 870 Wireways, Auxiliary Gutter, and Associated Fittings.
10. 1242 Intermediate Metal Conduits

I. Steel Structures Painting Council (SSPC)

1. PS-10.01 Hot-applied coal tar enamel painting system.

1.3 SUBMITTALS

- A. Product data for surface raceway, wireway and fittings, floor boxes, hinged cover enclosures, and cabinets.

1.4 QUALITY ASSURANCE

- A. Comply with latest edition of the NFPA 70 "National Electrical Code" for components and installation.

1. Boxes shall be sized in accordance with NEC Article 370.

- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

- C. Comply with NECA "Standard of Installation."
- D. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access.
- E. All outdoor boxes shall be rated minimum NEMA 3R.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Enclosures shall conform to NEMA standards.
- B. All materials procured under this specification shall be in accordance with FAA C-1217, FAA STD-019D, and FAA STD-020B.

2.2 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering Products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Metal Conduit and Tubing:
 - a. Allied Tube and Conduit, Grinnell Co.
 - b. George - Ingraham Corp.
 - c. Triangle PWC, Inc.
 - 2. Nonmetallic Tubing and Conduit:
 - a. Carlon.
 - b. Cole-Flex Corp.
 - c. George-Ingraham Corp.
 - 3. Conduit Bodies and Fittings:
 - a. Emerson Electric Co., Appleton Electric Co.
 - b. Hubbell, Inc., Killark Electric Manufacturing Co.
 - c. General Signal, O-Z/Gedney Unit.
 - 4. Wireway:
 - a. Hoffman Engineering Co.
 - b. Keystone/Rees, Inc.
 - c. Square D Co.
 - 5. Boxes, Enclosures, and Cabinets:
 - a. Scott Fetzer Company, Adalet-PLM.
 - b. Butler Manufacturing Co., Walker Division.

- c. Cooper Industries, Midwest Electric.
- d. Electric Panelboard Co., Inc.
- e. Erickson Electrical Equipment Co.
- f. American Electric, FL Industries.
- g. Hoffman Engineering Co., Federal-Hoffman, Inc.
- h. Hubbell Inc., Killark Electric Manufacturing Co.
- i. General Signal, O-Z/Gedney.
- j. Parker Electrical Manufacturing Co.
- k. Raco, Inc., Hubbell Inc.
- l. Robroy Industries, Inc., Electrical Division.
- m. Spring City Electrical Manufacturing Co.
- n. Square D Co.
- o. Thomas & Betts Corp.
- p. Woodhead Industries, Inc., Daniel Woodhead Co.

2.3 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1 and UL 6.
- B. Galvanized Rigid Steel Conduit: ANSI C80.1
- C. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
- D. Intermediate Metal Conduit (Zinc Coated): ANSI C80.6 and UL 1242.
- E. Electrical Metallic Tubing and Fittings: UL 797, and ANSI C80.3 with compression-type fittings.
 - 1. Connectors shall have insulated-throat, smooth bell shaped end or a bushing.
- F. Flexible Metal Conduit; Zinc-coated steel: UL 1 and Federal Specification WW-C-566.
 - 1. Conduit and fittings shall be type listed for grounding.
- G. Liquidtight Flexible Metal Conduit; Flexible steel conduit with PVC jacket: UL 360
- H. Flexible non-metallic conduit shall not be used.
- I. Fittings: UL 514B and NEMA FB 1, compatible with conduit and of the threaded type. Set Screw fittings are not allowed
 - 1. Underground fittings: Shall be protected by field wrapping, 0.01-inch thick pipe wrapping plastic tape applied with 50 percent overlap.

2.4 WIREWAYS

- A. Material: Sheet metal sized and shaped as indicated.
- B. Fittings and Accessories: UL 870. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireway as required for complete system. Provide ground bushings on galvanized rigid steel as indicated in PART 3 of this Section.

- C. Select features where not otherwise indicated, as required to complete wiring system and to comply with NEC.
- D. Wireway Covers: Hinged type, unless noted otherwise.
- E. Finish: Manufacturer's standard enamel finish.
- F. Provide NEMA rating appropriate for use intended

2.5 OUTLET AND DEVICE BOXES

- A. Sheet Metal Boxes: NEMA OS 1 and UL 514A.
- B. Cast Metal Boxes:
 - 1. NEMA FB 1, type FD, cast fer alloy box with gasketed cover.
- C. Fittings: UL 514B

2.6 PULL AND JUNCTION BOXES

- A. Small Sheet Metal Boxes: NEMA OS 1 and UL 514A.
- B. Cast Metal Boxes:
 - 1. Threaded-hub type conforming to UL 514A and UL 514B.
 - 2. Galvanized steel conforming to UL 514A and UL 514BB

2.7 CABINETS AND ENCLOSURES

- A. Hinged Cover Enclosures: NEMA 250, steel enclosure with continuous hinge cover and flush latch. Finish inside and out with manufacturer's standard enamel.
- B. Cabinets: NEMA 250, type 1, code gauge galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.
 - 1. Cabinets shall be constructed with interior dimensions not less than those indicated on the Drawings.
 - 2. Provide 5/8 inch plywood backboard unless otherwise indicated.
 - 3. Key latch to match panelboards. Provide two keys with each cabinet unless otherwise notified.
- C. Safety: UL 50
- D. Control Enclosures: NEMA 1CS-6
- E. Telephone and Signal Cabinets shall be constructed in accordance with NEC Article 373-10.
- F. All locks in project shall be keyed alike.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine raceways prior to installation. No crushed or deformed raceway shall be installed.

3.2 WIRING METHODS

- A. Outdoors: Use the following wiring methods:
 - 1. Exposed: Rigid or intermediate metal conduit.
 - 2. Concealed: Rigid or intermediate metal conduit.
 - 3. Underground, Single Run: PVC coated Rigid galvanized steel conduit.
 - 4. Underground, Grouped: PVC coated Rigid galvanized steel conduit.
 - 5. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquidtight flexible metal conduit.
 - 6. Boxes and Enclosures: NEMA Type 3R or Type 4.
 - 7. Other materials and fasteners use stainless steel.
- B. Indoors: Use the following wiring methods:
 - 1. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Flexible metal conduit, except in wet or damp locations use liquidtight flexible metal conduit.
 - 2. Damp or Wet Locations: Rigid steel conduit.
 - 3. Exposed: Rigid metal conduit or intermediate metal conduit. Rigid metal conduit shall be used in the electrical/mechanical room to a height of 8 feet above finished floor.
 - 4. Concealed: Electrical metallic tubing, or rigid metal conduit: EMT shall only be used for lighting receptacles, fire alarm, security, and environmental controls in concealed locations indoors.
 - 5. Boxes and Enclosures: NEMA Type 1, except in damp or wet locations use NEMA Type 4, stainless steel.
- C. Conduit Use:
 - 1. Install rigid steel conduit (RSC) or intermediate metal conduit (IMC) for all distribution panel feeders, transformer feeders, motor control center feeders, and distribution switchboards.
 - 2. Install electrical metallic tubing (EMT) for communication, lighting, and branch circuits.
 - 3. Use rigid steel conduit (RSC) for all exposed conduit systems within electrical and mechanical equipment rooms, electrical closets and loading dock from floor level to a height of 8 feet above finished floor. Conduit for communications, lighting and branch circuits may be transitioned to EMT above 8 feet.

3.3 INSTALLATION

- A. Products shall be installed in accordance with FAA-C-1217f, FAA STD-019d, and FAA STD-020b.
- B. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- C. Minimum size raceway shall be 3/4 inch, unless otherwise noted. Conduit for telephone and signal systems shall be as follows:
 - 1. 1/2-inch conduit may be used for lengths not exceeding 50 feet. 3/4-inch conduit may be used for lengths not exceeding 100 feet.
 - 2. 1-inch conduit shall be used for lengths exceeding 100 feet.
 - 3. No run shall contain more than two (2) 90 degree bends, or the equivalent.
 - 4. Provide pull and junction boxes required to meet the above criteria.
- D. Conceal conduit including EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.
- F. Install raceways level and square and at proper elevations. Provide adequate headroom.
- G. Complete raceway installation before starting conductor installation. Raceways shall be fished and swabbed before conductors are pulled.
- H. Support raceways and boxes as specified in Section 16190 "Supporting Devices."
 - 1. Boxes for fixtures on suspended ceilings shall be supported independently of the ceiling supports.
 - 2. Boxes shall not be supported from sheet-metal roof decks.
- I. Use temporary closures to prevent foreign matter from entering raceway.
- J. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- K. Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
 - 1. IMC Bends: Shall be fabricated with tooling specifically designed for bending IMC.
 - 2. Bends in conduit that is 1 inch and larger shall have a minimum inside radii 12 times the nominal conduit diameter.
- L. Use raceway fittings compatible with raceway and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, except as otherwise indicated.
- M. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions, except as otherwise indicated.
- N. Raceways Embedded in Slabs: Install in middle third of the slab thickness where practical, and leave at least 1 inch concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

2. Space raceways laterally to prevent voids in the concrete.
 3. Run conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. When at right angles to reinforcement, place conduit close to slab support.
- O. Raceways or sections of raceways which pass through to damp, concealed, or underground locations shall be of a type allowed for such locations by the NEC, and shall extend a minimum of 12 inches beyond the damp, concealed, or underground area.
- P. Floor and Wall Penetrations:
1. Penetrations through walls or floors shall be sealed to prevent moisture and rodent entry and to deter air transfer.
 2. Seal penetrations of walls which separate individually temperature or humidity controlled areas, to prevent air circulation.
- Q. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
1. Run parallel or banked raceways together, on common supports where practical.
 2. Make bends in parallel or banked runs from same center line to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.
- R. Join raceways with fittings designed and approved for the purpose and make joints tight.
1. Use bonding locknuts and bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
 2. Use insulating bushings for all conduits to protect conductors.
 3. Provide expansion fittings for all raceways passing through the building expansion joints.
- S. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, or where conduits enter enclosures without threaded hubs, use two locknuts, one inside and one outside the box to securely bond the conduit to the enclosure. In addition a bushing shall be installed on the interior threaded end of the conduit to protect conductor insulation.
- T. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
- U. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.
- V. Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs flush with floor.

- W. Flexible Connections: Use maximum of 6 feet of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations.
1. Under raised floor:
 - a. Flexible, liquid tight conduit may be used for branch circuits in lengths longer than 6 feet in computer room locations which meet requirements of NEC Article 645.
 - b. Fittings and junction boxes shall be liquid tight under raised floor.
- X. Install hinged cover enclosures and cabinets plumb. Support at each corner.
- Y. Provide grounding connections for raceway, boxes, and components as recommended by the component manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.
1. Provide ground bushings for all feeder conduits at switchgear, switchboards, panelboards, transformers, and pull boxes.
- Z. Field Cut Conduit: Where conduit has to be cut in the field, it shall be cut square using a hand or power hacksaw or approved pipe cutter using cutting knives. The cut ends of the field-cut conduit shall be reamed to remove burrs and sharp edges.
- AA. Field Threaded Conduit: Where threads have to be cut on conduit, the threads shall have the same effective length and shall have the same thread dimensions and taper as specified for factory-cut threads on conduit.
- BB. Surface Metal Raceways: Shall be installed only in exposed dry location not subject to physical damage. Raceways shall meet NFPA 70 requirements, and shall not be used for circuits above 600 volts
- CC. Boxes: Shall be provided in the wiring or raceway system for pulling wires, making connections, and mounting devices or fixtures. Each box shall have the volume required by NFPA 70 for the number and size of conductors in the box.
1. Outlet boxes: Each outlet box shall have a machine screw which fits into a tapped hole in the box for the ground connection.
 2. Mounting light fixtures: Boxes for mounting fixtures shall be not less than 4 inches square.
 3. Concealed wiring: Boxes installed for concealed wiring shall be provided with extension rings or plaster covers. The front edge of the box shall be flush or recessed not more than 1/4" from the finished wall surface (whether the finished surface is drywall, or drywall and a sound-absorbing material).
 4. Boxes in masonry block or tile walls: Shall be square-cornered tile-type, or standard boxes shall have square-cornered tile-type covers.
 5. Wet locations: Cast metal boxes installed in wet locations and boxes installed flush with exterior surfaces shall be gasketed.

- DD. IMC installed below slab on grade or underground: The conduit shall conform to SSPC-PS 10.01, or shall be field wrapped with 0.01 inch thick pipe wrapping plastic tape applied with 50 percent overlay.
- EE. EMT entering an enclosure without threaded hubs: Provide a connector with threads and cast or machined locknut. The connector body and locknut shall be installed so that firm contact is made on each side of the enclosure.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touch-up coating recommended by the manufacturer.

3.5 CLEANING

- A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 16100

SECTION 16111 - CABLE TRAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes cable trays and accessories.

1.2 REFERENCE STANDARDS

- A. American Society for Testing and Materials

- 1. B633 Electrodeposited Coatings of Zinc on Iron and Steel.
- 2. B766 Electrodeposited Coatings of Cadmium.

- B. Federal Aviation Administration (FAA)

- 1. C-1217f Electrical Work, Interior
- 2. STD-019d Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities.
- 3. STD-020b Transient Protection, Grounding and Shielding Requirements for Electronic Equipment.

- C. National Electrical Manufacturers Association (NEMA)

- 1. VE1 Metallic Cable Trays

- D. National Fire Protection Association (NFPA)

- 1. 70 National Electrical Code (NEC)

- E. Occupational Safety and Health Administration (OSHA)

- 1. 29CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL).

- F. Underwriters Laboratories (UL)

- 1. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors

1.3 SUBMITTALS

- A. Product data for each component. Show tray types, dimensions, and finishes.
- B. Shop drawings detailing fabrication and installation of cable tray, including plans, elevations, sections, details of components, and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice plates connectors, expansion joint assemblies, straight lengths, and fittings (tees and elbows, vertical and horizontal).

- C. Coordination drawings, including floor plans and sections drawn to accurate scale. Show accurately scaled cable tray layout and relationships between components and adjacent structural and mechanical elements.
- D. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.
- F. Factory certified test reports of specified products, conforming to NEMA VE 1.
- G. Field test reports indicating and interpreting test results relative to compliance with performance requirements specified in "Field Quality Control" Article of this Section.
- H. Maintenance data for cable tray, for inclusion in "Operating and Maintenance Manual". Include detailed manufacturer's instructions on tightening connections.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Select a firm experienced in manufacturing cable trays similar to those indicated for this Project and which has a record of successful in-service performance.
- B. Comply with NFPA 70, NEC, for components and installation.
- C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the NEC, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.
- D. Single-Source Responsibility: All cable tray components shall be the product of a single manufacturer.

1.5 SEQUENCING AND SCHEDULING

- A. Coordination: Coordinate layout and installation of cable tray with other installations.
 - 1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the COR.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide cable trays manufactured by one of the following:
 - 1. B-Line Systems, Inc.
 - 2. Chalfant Manufacturing Co.
 - 3. GS Metals Corp.
 - 4. MP Husky Corp.
 - 5. Mono-Systems, Inc.

6. P-W Industries, Inc.

2.2 MATERIALS AND FINISHES

- A. All Materials procured under this specification shall be in accordance with FAA C-1217, FAA STD 019, and FAA STD 020.
- B. Conform to NEMA VE 1.
- C. Cable Trays, Fittings, and Accessories: Hot dipped galvanized steel conforming to ASTM A123, Class B2.
- D. Protect steel hardware against corrosion by galvanizing conforming to ASTM B633 or cadmium plating conforming to ASTM B766.
- E. Fabricate cable tray products with rounded edges and smooth surfaces. Provide with plastic rung caps.

2.3 SIZES AND CONFIGURATIONS

- A. Conform to NEMA VE 1.
- B. Center Rung Trays: Center Supported type: Size as shown on the drawings.

2.4 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated on the drawings, manufactured with the same materials and finishes as the cable trays.
- B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.5 FIRESTOPPING

- A. Materials: UL listed and labeled and FM approved for fire ratings consistent with penetrated barriers.
- B. Materials: NRTL listed and labeled for fire ratings consistent with penetrated barriers.
- C. Sleeves: Schedule 40, welded, black steel pipe sleeves. Sizes as indicated or minimum NEC size for cable or cable group to be installed.
- D. Sealing Fittings: Suitable for sealing cables in sleeves or core drilled holes.
- E. Two-Part Sealant: Formed-in-place sealant.

2.6 WARNING SIGNS

- A. Lettering: 1-1/2 inch high, black on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

- B. Materials and Fastening: Conform to Section 16195 "Electrical Identification."

2.7 SOURCE QUALITY CONTROL

- A. Perform design and production tests according to NEMA VE 1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive cable tray for compliance with installation tolerances and other required conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRING METHODS

- A. Use cable tray of indicated types and sizes, complete with manufacturer's recommended covers, barrier strips, dropouts, fittings, conduit adapters, hold-down devices, grommets, and blind ends.

3.3 INSTALLATION

- A. Materials shall be installed in accordance with FAA C-1217f, FAA STD-019d, and FAA STD -020b.
- B. Install cable tray level and plumb according to manufacturer's written instructions, rough-in drawings, the original design, and referenced standards.
- C. Remove burrs and sharp edges of cable trays.
- D. Fasten cable tray supports securely to the building structure as specified in Division 16 Section 16190 "Supporting Devices" unless otherwise indicated.
 - 1. Locate and install supports according to recommendations of NEMA VE 1 and the manufacturer, except that in no case shall spacing of supports exceed 6 feet.
 - 2. Design supports, including fastenings to the structure, to carry the greater of the calculated load multiplied by a safety factor of 4, or the calculated load plus 200 lbs.
- E. Make connections to equipment with flanged fittings fastened to the tray and to the equipment. Support the tray independently of fittings. Do not carry the weight of the tray on the equipment enclosure.
- F. Install expansion connectors in cable tray runs that exceed 90 feet. Space connectors and set gaps according to NEMA VE 1.
- G. Make changes in direction and elevation using standard fittings.
- H. Make cable tray connections using standard fittings.
- I. Locate cable tray above piping except as required for tray accessibility and as otherwise indicated.
- J. Firestop penetrations through fire and smoke barriers according to manufacturer's instructions.

- K. Firestop penetrations through fire and smoke barriers, including walls, partitions, floors, and ceilings, after cables are installed.
- L. Sleeves for Future Cables: Install capped sleeves for future cables through firestopped cable tray penetrations of fire and smoke barriers.
- M. Working Space: Install cable trays with sufficient space to permit access for installing cables.

3.4 GROUNDING

- A. Connect cable trays to ground in accordance with the NEC and as recommended by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.
- B. Material and equipment installed at this facility shall be grounded in accordance with FAA C-1217f and FAA-STD-019d.
- C. The individual sections of cable tray systems for electronic conductors shall be bonded together and each support bracket or hanger shall be bonded to the cable trays which they support. Bonds shall be in accordance with the procedures and requirements specified in FAA-STD-019d. Tray assemblies shall be connected to properly grounded facility steel within 2 feet of each end of the run and at intervals not exceeding 50 feet. The resistance of each of these connections shall not exceed 5 milliohms.

3.5 FIELD QUALITY CONTROL

- A. Grounding: Test cable trays to ensure electrical continuity of bonding and grounding connections.
- B. Anchorage: Test pull-out resistance of one of each type, size, and anchorage material for toggle bolts and powder-driven threaded studs.
 - 1. Furnish equipment, including jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain Architect's approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener.
- C. Correct malfunctioning units at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.6 CLEANING

- A. Upon completion of installation of system, including fittings, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes, including chips, scratches, and abrasions.

3.7 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer to ensure that the cable tray is without damage or deterioration at Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by the tray manufacturer.

END OF SECTION 16111

SECTION 16120 - WIRES AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes building wires and cables and associated splices, connectors, and terminations for wiring systems rated 600 volts and less.

1.2 REFERENCE STANDARDS

A. National Electrical Manufacturers Association. (NEMA)

- 1. WC 3 Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- 2. WC5 Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

B. Federal Aviation Administration (FAA)

- 1. C-1391b Installation and Splicing of Underground Cables.
- 2. C-1217f Electrical Work, Interior
- 3. STD 019d Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities.
- 4. STD 020b Transient Protection, Grounding and Shielding Requirements for Electronic Equipment.

C. Federal Specification (FS)

- 1. W-S-610 Splice Connectors
- 2. QQ-W-343 Wire, Electrical, Copper, Uninsulated

D. National Electrical Contractors Association (NECA)

- 1. Standard of Installation

E. InterNational Electrical Testing Association (NETA)

- 1. ATS Acceptance Testing Specification for Electric Power Distribution Equipment and Systems

F. National Fire Protection Association (NFPA)

- 1. 70 National Electrical Code (NEC)

G. Occupational Safety and Health Administration (OSHA)

- 1. 29 CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL).

H. Underwriters Laboratories (UL)

1. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.

1.3 SUBMITTALS

- A. Field test reports indicating and interpreting test results relative to compliance with performance requirements of testing standard.

1.4 QUALITY ASSURANCE

- A. Testing Firm Qualifications: An independent testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1910.7, or shall be a full member company of the International Electrical Testing Association (NETA).

1. Testing Firm's Field Supervisor Qualifications: A person currently certified by the NETA National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

- B. Comply with NFPA 70, NEC, for components and installation.

- C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled": As defined in the NEC, Article 100.
 2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

- D. Installer Qualifications: Cable splices shall be performed by experienced and qualified cable splicers. The workmen shall be licensed if required by the authority having jurisdiction.

1.5 SEQUENCING AND SCHEDULING

- A. Coordination: Coordinate layout and installation of cable with other installations.

1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the COR.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wire and cable according to NEMA WC-26.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials procured and installed in this Section shall be in accordance with FAA-C-1217f, FAA Std-019d, and FAA STD-020b.

2.2 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Wires and Cables:

- a. American Insulated Wire Corporation, Leviton Manufacturing Co.
- b. Brand-Rex Cable Systems, Brintec Corp.
- c. Carol Cable Company, Inc.
- d. Senator Wire & Cable Co.
- e. Southwire Co.

2. Connectors for Wires and Cables:

- a. AFC, Monogram Co.
- b. AMP, Inc.
- c. Anderson, Square D Co.
- d. Electrical Products Division, 3M Co.
- e. O-Z/Gedney Unit, General Signal.

2.3 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Applications" Article.
- B. Rubber Insulation: Conform to NEMA WC 3.
- C. Thermoplastic Insulation: Conform to NEMA WC 5.
- D. Solid conductor for 10 AWG and smaller; stranded conductor for larger than 10 AWG.
- E. All wire and conduit sizes are based on copper conductors with 75 degrees C insulation.
- F. Size: Minimum 12 AWG. Minimum 10 AWG for 120 volt circuits where circuit length (one way) exceeds 75 feet from source, and 10 AWG for 277 volt circuits where circuit length (one way) exceeds 150 feet from source. Communication systems wiring size shall be in accordance with Manufacturer's requirements.
1. Stranded conductors may be used with wire compression connectors or a pressure washer type lug.
 2. Stranded conductors smaller than 10 AWG are allowed in applications where vibration and flexing may be encountered.
- G. Material: Copper only for the power system.
- H. Conductor Color Codes: Refer to Section 16195, "Electrical Identification," for conductors No. 4 AWG and larger, where factory color coding is not available.
1. Feeder conductors to panels and three phase circuits shall be factory color coded as follows:

- a. 208/120 (240) Volt System
 - 1) Phase A: Black
 - 2) Phase B: Red
 - 3) Phase C: Blue
 - 4) Neutral: White
 - 5) Ground: Green
- b. 480/277 Volt System
 - 1) Phase A: Yellow
 - 2) Phase B: Brown
 - 3) Phase C: Orange
 - 4) Neutral: Grey/White
 - 5) Ground: Green
- 2. Single-phase branch circuits shall be factory color coded as stated above, or identified in accordance with Section 16195, "Electrical Identification."
- 3. Switch leg conductors shall be violet insulated.
- 4. Control Cables shall be IAW NEMA WC5.
- 5. DC Power Cables shall be as follows:
 - a) + : red/brown tracer
 - b) - : brown/red tracer
 - c) N : white (if used)
- I. Uninsulated conductors shall be copper and compy with F.S. QQW-343.

2.4 CONNECTORS AND SPLICES

- A. UL-listed factory-fabricated wiring connectors of size, ampacity rating, material, and type and class for application and for service indicated. Select to comply with Project's installation requirements and as specified in Part 3 "Applications" Article.
- B. Splice Envelopes:
 - 1. Power cables 600 volts and below: Cast or pressure expoy resin splice envelopes or equal, or taped splice using a prestretched or heat-shrinkable tubing covering . Known acceptable source for all direct earth burial cable: 3M Co. or approved equal.
 - 2. Control and telephone cables: Reenterable filled splice envelope Known acceptable source: Scotch brand 3925 or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with installation tolerances and other conditions. Verify that the duct or conduit is open, continuous, and clear of debris before installing cable. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Feeders: Type THHN/THWN, copper conductor, in raceway.
- B. Indoor Branch Circuits: Type THHN/THWN, copper conductor, 90 degree C insulation in raceway. For use in dry locations only for lighting and receptacle circuits.
- C. Exterior Branch Circuits: Type THWN, copper conductor, 75 degree C insulation, in raceway.
- D. Fire Alarm Power Circuits: Type THHN/THWN, copper conductor, in raceway.
- E. Under Access Flooring Cable: Type THHN, copper conductor, 90 degree C in flexible metal conduit with attached connectors.
- F. Communication System wiring (to include telephone cable, fire alarm cable, security wiring, intercommunication wiring and public address/music system) shall be as specified under applicable sections and specific requirements of the NEC. Use copper wire or fiber optics cable only. Aluminum wire is not permitted.
- G. All underfloor wiring in air plenums of the raised floors must either be enclosed in raceway or be plenum-rated.

3.3 INSTALLATION

- A. Materials procured and installed in this Section shall be in accordance with FAA-C-1217f, FAA Std-019d, FAA STD-020b, and FAA FAA-C-1391b.
- B. Install wires and cables as indicated, according to manufacturer's written instructions and the NECA "Standard of Installation."
- C. Pull conductors into raceway simultaneously where more than one is being installed in same raceway.
 - 1. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
 - 2. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- D. Cable shall be installed in a manner to prevent harmful stretching of the conductor, injury to the insulation or damage to the outer protective covering.
- E. Install exposed cable, parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.
- F. The ends of cables shall be sealed with moisture-seal tape before pulling, and it shall be left sealed until connections are made.
- G. Conductor Splices:
 - 1. Splices shall be made only at outlets, junction boxes, or accessible raceways.

2. Splices shall be made with solderless connectors conforming to FS W-S-610.
3. Insulated wire nuts may only be used to splice conductors sized No. 10 AWG and smaller.
4. Compression connectors shall be used to splice conductors No. 8 and larger.
5. All splices, including those made with insulated wire nuts, shall be insulated with electrical tape or heat-shrink tubing to a level equal to that of the factory insulated conductors.
6. Splicing of ungrounded conductors in panelboards is not permitted.
7. Splices shall be made with solderless connectors conforming to UL 486A, UL 486C, and UL 486E.
8. No splices shall be allowed on critical feeders. Critical circuits are identified on drawings.
9. Install splices and insulating tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
10. Use splice and tap connectors that are compatible with conductor material.
11. Splicing methods and material shall be of a type recommended by the manufacturer of the splicing material for the particular type of cable being spliced and shall be approved by the COR prior to installation

H. Wiring at Outlets: Install with at least 12 inches of slack conductor at each outlet.

I. Connect outlets and components to wiring and to ground as indicated. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

J. Conductors for critical circuits, emergency lighting, security systems, and fire alarm systems shall be kept completely independent from any other system as well as each other.

K. Cables/conductors sizes 250 MCM and greater shall be installed with the use of a hydraulic cable bender. Cable supports shall be required for stress relief.

L. A splice shall not be pulled into a duct or conduit under any circumstance.

M. Grounding: Materials and equipment installed at this facility shall be grounded in accordance with FAA-C-1217F.

3.4 FIELD QUALITY CONTROL

A. Testing, General: Cables shall be tested prior to installation and again upon completion of the installation. Testing shall be accomplished before connection is made. Tests shall be performed in the presence of the COR.

1. Upon installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - a. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.3.1. Certify compliance with test parameters.
 - b. Test wire and cable for continuity or circuitry, and also for short circuits.

B. Insulation Resistance Tests: Feeder and Branch Circuit insulation tests shall be performed after installation, but before connection to equipment.

1. Conductors shall test free from short circuits and grounds, and have a minimum phase-to-phase and phase-to-ground insulation resistance of 30 megohms when measured with a 500-volt DC insulation resistance tester. The contractor shall submit a letter type test report to the COR prior to final inspection of the Work. The report shall list the tests performed and results obtained.
 - a. Apply the test voltage for at least one minute after motor reading has stabilized.
2. Contractor shall use FAA meggar form located at the end of this Section.
- C. Correct malfunctioning products at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.
- D. Nitrogen Gas Pressure Test: Prior to installation, determine if the nitrogen gas shipping pressure is still retained in the cable. If the gas pressure reading varies more than minus one pound and the loss is not due to temperature change, a nitrogen gas test shall be conducted.
 1. Test: Nitrogen gas at 15 pounds per square inch regulator gas pressure shall be applied to the cable, the gas valve closed, and ambient temperature recorded. Six Successive, hourly readings will be taken and recorded. After the sixth reading is taken and after a time interval of about 24 hours, a seventh reading shall be made of the pressure gage. If variations in gas pressure are due only to changes in ambient temperature, the length of cable is acceptable. A temperature correction factor of .0094 pounds per degree F shall be used. (Per FAA-C-1391b).

END OF SECTION 16120

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SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes various types of receptacles, connectors, switches, and finish plates.

1.2 REFERENCE STANDARDS

A. Federal Aviation Administration (FAA)

- 1. C-1217f Electrical Work, Interior
- 2. STD 019d Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities
- 3. STD-020b Transient Protection, Grounding and Shielding Requirements for Electronic Equipment

B. Federal Specifications (FS)

- 1. W-C-596 General and Associated Detailed Specifications: Connector, Plug Receptacle, and Cable Outlet, Electrical Power
- 2. W-S-896E Switch, Toggle, Flush Mounted

C. National Electrical Manufacturer Association (NEMA)

- 1. WD1 General Requirements for Wiring Devices

D. National Fire Protection Association (NFPA)

- 1. 70 National Electrical Code (NEC)

E. Occupational Safety and Health Administration (OSHA)

- 1. 29 CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL)

E. Underwriters Laboratories (UL)

- 1. 20 General Use Snap Switches
- 2. 498 Electrical Attachment Plugs and Receptacles
- 3. 943 Ground Fault Circuit Interrupters

1.3 SUBMITTALS

- A. Product data for each product specified.
- B. Operation and maintenance data for materials and products specified in this Section to be included in the "Operating and Maintenance Manual".

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70, NEC, for devices and installation.
- B. Listing and Labeling: Provide products that are listed and labeled for their applications and installation conditions and for the environments in which installed.
 - 1. The Terms "Listed" and "Labeled": As defined in the NEC," Article 100.
 - 2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

1.5 COORDINATION

- A. Wiring Devices for Government Furnished Equipment: Match devices to plug connectors for Government-furnished equipment.
- B. Wiring devices and device plates color shall be white except in HVAC, plumbing and electrical equipment areas which shall be brown or as required by code. Computer receptacle plates shall be orange and receptacle plates on critical circuits shall be red.
- C. Wiring devices for power and data outlets located under access flooring, shall be coordinated with Section 10270 "Access Flooring."

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials procured and installed in this Section shall be in accordance with FAA C-1217f, FAA Std-019d, and FAA Std- 020b.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices:
 - a. Arrow Hart Div., Cooper Industries.
 - b. Bryant Electric, Inc.
 - c. General Electric Co.
 - d. Hubbell Inc.
 - e. Leviton Mfg. Co., Inc.
 - f. Pass & Seymour/Legrand.
 - g. Slater Electric, Inc.
 - 2. Time Delay Switch: Known acceptable source: Loren Cook Company or approved equal.

2.3 WIRING DEVICES

- A. Comply with NEMA Standard WD 1, "General Purpose Wiring Devices," and UL approved, specification grade.
- B. Enclosures: NEMA 1 equivalent, except as otherwise indicated.

- C. Receptacles, General: All receptacles shall be specification grade in accordance with NEMA WD 1. Wiring terminals shall be of the screw-type. Receptacles with push-in connections or a combination of screw-type and push-in connectors are not acceptable.
- 1 Straight-Blade and Locking Type: Except as otherwise indicated, comply with Federal Specification W-C-596 and heavy-duty grade of UL Standard 498, "Electrical Attachment Plugs and Receptacles." Provide NRTL labeling of devices to verify these compliances.
 - a. Critical power circuits: Receptacles shall be twist lock type, except for receptacles mounted inside an equipment rack.
 2. General Purpose Duplex Receptacle: 125 volt, 20 AMP, 2 pole, 3 wire grounded, NEMA 5-20R.
 - a. Outlet grounding shall be accomplished by the installation of a #12 AWG green insulated conductor from the ground bus in the panelboard to the receptacle grounding screw of the receptacle. A pigtail #12 AWG conductor shall also be installed from the receptacle grounding screw to the grounding lug on the outlet box.
 3. Emergency light receptacles: Shall be grounding type single receptacles.
- D. Receptacles, Straight-Blade, Special Features: Comply with the basic requirements specified above for straight-blade receptacles of the class and type indicted, and with the following additional requirements:
1. Ground-Fault Circuit Interrupter Receptacles: UL Standard 943, "Ground Fault Circuit Interrupters," feed-through type, with integral NEMA 5-20R (UL Group I, Class A), duplex receptacle arranged to protect connected downstream receptacles on the same circuit. Design units for installation in a 2-3/4-inch deep outlet box without an adapter.
- E. Multi-Outlet Assemblies
1. Fixed multi-outlet assemblies shall consist of a surface metal raceway with receptacles.
 2. Surface metal raceways shall be provided with snap-on blank covers and snap-on receptacle covers for the receptacles furnished and shall be single source manufacturer.
 3. Fittings, elbows, clips, mounting straps, connection blocks, and insulators, shall be provided as required for a complete installation.
- F. Wall Switches:
1. Snap Switches: AC switches, NRTL listed and labeled as complying with UL Standard 20 "General Use Snap Switches", and with Federal Specification W-S-896E.
 - a. Single-pole and three-way wall switches shall be specification grade, rated 120/277 volts, and shall be fully rated 20 amperes, AC only.
 - b. Wire terminals shall be of the screw type.
 - c. Switches with push-in connections or a combination of screw -type and push-in connectors are not acceptable.
 - d. Switches shall be the quiet-operating type.

2. Dimmer Switches: Modular full-wave solid-state units with integral, quiet on-off switches, and audible and electromagnetic noise filters.
 - a.. Wattage rating exceeds connected load by 30 percent minimum, except as otherwise indicated.
 - b. Control: Continuously adjustable linear slide type. Single-pole or 3-way switch to suit connections.
 - c. Incandescent Lamp Dimmers: Modular dimmer switches for incandescent fixtures; switch poles and wattage as otherwise indicated, 120 V, 60 Hz with continuously electromagnetic filter to eliminate noise, RF and TV interference, and 5-inch wire connecting leads.
 - d. Modular full-wave solid-state units with integral, quiet on-off switches, and audible and electromagnetic noise filters.
3. Fluorescent Lamp Dimmers: Modular dimmer switches compatible with dimmer ballasts. Trim potentiometer adjusts low-end dimming. Dimmer-ballast combination is capable of consistent dimming to one foot candle brightness.
4. Time Delay Switch: For operation of exhaust fan and room light. When switch is turned to the "ON" position, the room light turns on immediately and exhaust fan activates on a time delay of 15 seconds. Both the light and fan remain on until the switch is moved to the "OFF" position. The light turns off immediately and the exhaust fan turns off after a one to ten minute adjustable delay. Provide the switch with a 277 volt step-down transformer.

G. Device Plates

1. Provide plates of one-piece type for all outlets and fittings to suit the devices installed. Plate screw shall be metal with countersunk heads, in a color to match the finish of the plate. Device plate color shall be approved by the COR.
 - a. Plates installed in wet locations shall be gasketed.
 - b. Plates for telephone and intercommunication outlets shall have a 3/8 inch bushed opening in the center or a dome-shaped grommet on the side. Plates for telephone may be more than one-piece type where required.
 - c. Telephone and communication outlets shall be provided with a blank cover plate unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Arrangement of Devices: Except as otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- D. Install connectors for under access flooring as required by manufacturer and as indicated on drawing detail.

E. Multi-outlet Assemblies Installation:

1. Phase and neutral conductors shall not be smaller than No. 12 AWG and shall have the type of insulation specified for branch circuit conductors.
2. A No. 12 AWG or larger green insulated equipment grounding conductor having the same insulation as the phase conductors and meeting requirements of the NFPA 70, shall be installed.
 - a. The grounding conductor shall connect all receptacle ground terminals and each section of the surface metal raceway, and shall be securely connected to the equipment grounding conductor from the branch power panel.
 - b. Where more than one circuit is indicated as serving a group of similar receptacles in a common raceway, adjacent receptacles shall not be connected to the same circuit.
3. Associated hardware: Install blank covers and receptacle covers in a manner which prevents open cracks. Where industry standard device plates are to be installed on raceways, snap-on blank covers shall be accurately cut to avoid open cracks.

F. Wall Switches:

1. Not more than one switch shall be installed in a single gang position.
2. Grounding: Where switches have grounding terminals, they shall be grounded with a green grounding pigtail connected from the switch grounding screw directly to the grounding lug on the outlet box where the green equipment grounding conductor is terminated.

G. Device Plates:

1. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without use of mats or similar devices.
2. Plates installed in wet locations shall be gasketed.
3. Use of sectional type device plates shall not be permitted.

H. The equipment grounding conductor shall be installed with the receptacle power conductors and shall terminate at the ground bus in the electrical service panel.

I. Receptacles shall be installed 18 inches above finished floor, unless noted otherwise.

J. Protect devices and assemblies during painting.

3.2 IDENTIFICATION

A. Comply with Section 16195 "Electrical Identification."

1. Receptacles: Receptacles identified on the Drawings as computer receptacles, shall be a different color than other 120 volt receptacles.

3.3 GROUNDING

- A. Grounded Receptacles: Connect to grounding conductor routed to designated ground terminal of electrical system.

3.4 FIELD QUALITY CONTROL

- A. Testing: Test wiring devices for proper polarity and ground continuity. Operate each operable device at least 6 times.
- B. Test ground-fault circuit interrupter operation with both local and remote fault simulations according to manufacturer recommendations.
- C. Replace damaged or defective components.

3.5 CLEANING

- A. General: Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 16140

SECTION 16190 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.2 REFERENCE STANDARDS

- A. Federal Aviation Administration (FAA)
 - 1. C-1217f Electrical Work, Interior
 - 2. Std-019d Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities.
 - 3. Std-020b Transient Protection, Ground and Shielding Requirement for Electronic Equipment.
- B. National Fire Protection Association (NFPA)
 - 1. 70 National Electrical Code (NEC)
- C. Underwriters Laboratories (UL)

1.3 SUBMITTALS

- A. Product data for each type of product specified.

1.4 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70.
- B. Electrical components shall be listed and labeled by UL or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials procured and installed in this Section shall be in accordance with FAA-C-1217f, FAA Std-019d and FAA Std-020b.

2.2 COATINGS

- A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

2.3 MANUFACTURED SUPPORTING DEVICES

- A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
- B. Fasteners: Types, materials, and construction features as follows:
 - 1. Expansion Anchors: Carbon steel wedge or sleeve type.
 - 2. Toggle Bolts: All steel springhead type.
 - 3. Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for the intended service.
- C. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.
- D. U-Channel Systems: 16-gage steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.
- E. Conduit Sealing Bushings: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in conduits subject to exposure to water and/or oil penetration at conduit joints. Provide plugs with number and size of conductor gripping holes as required to suit installation. Construct body of malleable iron casting with hot-dipped galvanized finish.
- F. Support systems shall be capable of carrying the weight of the box and its contents.

2.4 FABRICATED SUPPORTING DEVICES

- A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.
- B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
- C. Pipe Sleeves: Provide pipe sleeves for steel pipe to be fabricated from Schedule 40 galvanized steel pipe.
- D. Supporting devices shall meet the seismic requirements of Zone 4.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.
- B. Coordinate with the building structural system and with other electrical installation.
- C. Raceway Supports: Comply with the NEC and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.
 2. Strength of each support shall be adequate to carry design load plus 25 percent for future use, multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lb., provide additional strength until there is a minimum of 200 lb. safety allowance in the strength of each support.
 3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
 4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
 5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
 6. Space supports for raceways in accordance with Table I of this section. Space supports for raceway types not covered by the above in accordance with NEC.
 7. Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.
 8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
 9. Neither raceways nor boxes shall be fastened to suspended ceiling supports.
- D. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.
- E. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.
1. Cast metal boxes having threadless connectors and sheet-metal boxes shall be supported directly from the building structure or by bar hangers.
- F. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and walls for raceways and cable installations. For sleeves through fire-rated-wall or floor construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables in accordance with manufacturer's instructions.
- G. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, lighting fixtures, and control components in accordance with the following:
1. Fasten by means of wood screws, nails, screw-type nails, carriage bolts, or lag screws of equal holding strength on wood; toggle bolts on hollow masonry units; concrete inserts or expansion

- bolts on concrete or solid masonry; and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
 3. Coordinate any cutting or boring of structural beams with Structural Engineer prior to any work being done.
 4. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock- resistant fasteners for attachments to concrete slabs.
 5. Coordinate with structural engineer on expansion joints used to support raceways.
- H. Tests: Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:
1. Expansion anchors.
 2. Toggle bolts.
 3. Powder-driven threaded studs.
- I. Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain the structural Engineer's approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.

3.2 TABLE I: SPACING FOR RACEWAY SUPPORTS

HORIZONTAL RUNS

Raceway Size (Inches)	No. of Conduits in Run	Location	RMC & IMC (1)	EMT (1)
1/2,3/4	1 or 2	Flat ceiling or wall.	5	5
1/2,3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7	7
1/2,3/4	3 or more	Any location.	7	7
1/2-1	3 or more	Any location.		
1 & larger	1 or 2	Flat ceiling or wall.	6	6
1 & larger	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	10	10

1 & larger	3 or more	Any location.	10	10
Any	Concealed.	10	10

VERTICAL RUNS

Raceway Size (Inches)	No. of Conduits in Run	Location	RMC & IMC (1)	EMT (1)
1/2,3/4	Exposed.	7	7
1,1-1/4	Exposed.	8	8
1-1/2 and larger	Exposed.	10	10
Up to 2	Shaftway.	14	10
2-1/2	Shaftway.	16	10
3 & larger	Shaftway.	20	10
Any	Concealed.	10	10

NOTES:

- (1) Maximum spacing of supports (feet).
 (2) Maximum spacings for IMC above apply to straight runs only.
 Otherwise, the maximums for EMT apply.

<u>Abbreviations:</u>	EMT	Electrical metallic tubing.
	IMC	Intermediate metallic conduit.
	RMC	Rigid metallic conduit.

END OF SECTION 16190

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SECTION 16195 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components, including but not limited to the following:
 - 1. Buried electrical line warnings.
 - 2. Identification labeling for raceways, cables, and conductors.
 - 3. Operational instruction signs.
 - 4. Warning and caution signs.
 - 5. Equipment labels and signs.

1.2 REFERENCE STANDARDS

- A. American Standards Institute (ANSI)
 - 1. A13.1 Scheme for the Identification of Piping Systems
- B. Federal Aviation Administration (FAA)
 - 1. C-1217f Electrical Work, interior
- C. National Fire Protection Association (NFPA)
 - 1. 70 National Electrical Code (NEC)

1.3 SUBMITTALS

- A. Product Data for each type of product specified.
- B. Schedule of identification nomenclature to be used for identification signs and labels.
- C. Samples for each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.

1.4 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70.
- B. ANSI Compliance: Comply with requirements of ANSI standard A13.1, with regard to type and size of lettering for raceway and cable labels.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.

- B. Coordinate installing electrical identifying devices and markings prior to installing acoustical ceilings and similar finishes that conceal such items.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials procured and installed in this Section shall be in accordance with FAA C-1217f. Identification and nameplates shall be in accordance with FAA C-1217f, paragraphs 4.16 and 4.16.1,

2.2 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Brady USA, Inc.; Industrial Products Div.
 - 2. Cole-Flex Corp.
 - 3. George-Ingraham Corp.
 - 4. Ideal Industries, Inc.
 - 5. Panduit Corp.
 - 6. Seton Name Plate Co.
 - 7. Standard Signs, Inc.

2.3 RACEWAY AND CABLE LABELS

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.
 - 1. Color: Black legend on orange field.
 - 2. Legend: Indicates voltage and service.
- C. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl. Legend is laminated with a clear, weather- and chemical-resistant coating.
- D. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic bands sized to suit the diameter of the line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.
- E. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- F. Underground Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
 - 1. Size: Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.

4. Printed Legend: Indicates type of underground line.
- G. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- H. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch-thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- I. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.
- J. Aluminum-Faced Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch thick, laminated with moisture-resistant acrylic adhesive, and punched for the fastener. Preprinted legends suit each application.
- K. Copper, Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener. Dimensions: Tags shall be circular in shape, two inches minimum diameter, by 0.02 inch thick for copper or by 0.05 inch thick for brass or aluminum.

2.4 ENGRAVED NAMEPLATES AND SIGNS

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Engraving stock, melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 sq. in. or 8 inches in length; 1/8 inch thick for larger sizes.
 1. Engraved Legend: white letters on black face.
 2. Punched for mechanical fasteners.
- C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for the application. 1/4-inch grommets in corners for mounting.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396-inch, galvanized steel backing, with colors, legend, and size appropriate to the application. 1/4-inch grommets in corners for mounting.
- E. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties with the following features:

1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb minimum.
3. Temperature Range: Minus 40 to 185 deg F.
4. Color: As indicated where used for color coding.

B. Paint: Alkyd-urethane enamel over primer as recommended by enamel manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations used in the Contract Documents or required by codes and standards. Use consistent designations throughout the Project
- C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
- D. Self-Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.
- E. Identify Raceways and Exposed Cables of Certain Systems with Color Banding and Black Lettering Appropriately Sized for Conduit: Band exposed and accessible raceways of the systems listed below for identification.
 1. Bands: Pre-tensioned, snap-around, colored plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of 2-color markings in contact, side by side.
 2. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25 feet in congested areas.
 3. Colors: As follows:
 - a. Fire-Alarm System: Red.
 - b. Fire-Suppression Supervisory and Control System: Red and yellow.
 - c. Combined Fire-Alarm and Security System: Red and blue.
 - d. Security System: Blue and yellow banding only, no lettering.
 - e. Mechanical and Electrical Supervisory System: Green and blue.
 - f. Telecommunications System: Green and yellow.
- F. Install Circuit Identification Labels on Boxes: Label externally as follows:
 1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
 2. Concealed Boxes: Plasticized card-stock tags.
 3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
- G. Identify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground plastic line marker

located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope do not exceed an overall width of 16 inches, use a single line marker.

1. Install line marker for underground wiring, both direct buried and in raceway.
- H. Color-Code Conductors: The following field-applied color-coding methods may be used in lieu of factory-coded wire listed in Section 16120 "Wires and Cables" for sizes larger than No. 4 AWG. Contractor shall demonstrate non-availability of factory colored wire before using this application
1. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last 2 turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.
 - a. Where conductors are color coded by this method, they shall be color coded in accessible raceways, panelboards, outlets, and switches, as well as at all terminations. Conductors in accessible raceways shall be color coded so that by removing or opening any cover, the coding will be visible.
 - b. Phase, ground, and neutral conductors shall be color coded in accordance with Section 16120, "Wires and Cables."
 2. Green insulated conductors shall not be re-identified for purposes other than grounding.
 3. White or neutral grey conductors shall not be re-identified for purposes other than grounded neutrals.
- I. Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in pull boxes, junction boxes, handholes, and switchboard rooms.
1. Legend: 1/4-inch-steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
 2. Fasten tags with nylon cable ties; fasten bands using integral ears.
- J. Apply identification to conductors as follows:
1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit.
 3. Multiple Control and Communications Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color coding, or cable marking tape.
- K. Apply warning, caution, and instruction signs and stencils as follows:
1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic-laminated instruction signs with approved legend where instructions or

explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.

2. Emergency-Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch-high lettering for emergency instructions on power transfer, and other emergency operations.

L. Install identification as follows:

1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide a single line of text with 1/2-inch- high lettering on 1-1/2-inch-high label; where 2 lines of text are required, use lettering 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment.
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Electrical switchgear and switchboards.
 - d. Motor control centers.
 - e. Motor starters.
 - f. Push-button stations.
 - g. Power transfer equipment.
 - h. Contactors.
 - i. Remote-controlled switches.
 - j. Dimmers.
 - k. Control devices.
 - l. Transformers.
 - m. Inverters.
 - n. Rectifiers.
 - o. Battery racks.
 - p. Power-generating units.
 - q. Telephone switching equipment.
 - r. Fire-alarm master station or control panel.
 - s. Security-monitoring master station or control panel.
2. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.
3. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
4. Tag cables in each manhole or handholes with not less than two tags per cable, one near each duct entrance hole.
 - a. Attach tags to cable immediately after installation.
 - b. Cable terminations shall be tagged as to function.
 - c. Attach securely to cable using 1/8 inch nylon cord.

END OF SECTION 16195

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SECTION 16452 - GROUNDING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes solid grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other Sections of these Specifications.

1.2 REFERENCED STANDARDS

- A. American Society for Testing and Materials (ASTM)

- 1. B3 - Soft or Annealed Copper Wire
 - 2. B8 - Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft.
 - 3. B33 - Tinned Soft or Annealed Copper Wire for Electrical Purposes.

- B. Federal Aviation Administration (FAA)

- 1. C-1217f - Electrical Work, Interior
 - 2. Std-019d - Lightning Protection, Grounding, Bonding and shielding Requirements for Facilities.
 - 3. Std-020b - Transient Protection, Grounding and Shielding requirements for Electronic Equipment.
 - 4. Order 6950.19A - Practices and Procedures for Lightning Protection, Grounding, Bonding, and Shielding Implementation.

- C. Institute of Electrical and Electronic Engineers (IEEE)

- 1. 81 - Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
 - 2. 1100 - Powering and grounding sensitive electronic equipment.

- D. InterNational Electrical Testing Association (NETA)

- E. National Fire Protection Association (NFPA)

- 1. 70 - National Electrical Code (NEC)
 - 2. 78 - Lightning Protection Code

- F. Occupational Safety and Health Administration (OSHA)

- 1. 29CFR 1910.7 Definitions and requirements for Nationally Recognized Testing Laboratories (NRTL).

- G. Underwriters Laboratories (UL)

- 1. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors

2. 467 - Grounding and Bonding Equipment

1.3 SUBMITTALS

- A. Product Data for grounding rods, connectors and connection materials, and grounding fittings.
- B. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- C. Field tests and observation reports certified by the testing organization and indicating and interpreting the test reports for compliance with performance requirements.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7, or a full member company of NETA.
 - 1. Testing Agency Field Supervision: Use persons currently certified by NETA or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Comply with NFPA 70, National Electrical Code.
- C. Comply with UL 467.
- D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials procured and installed in this Section shall be in accordance with FAA C-1217f, FAA Std-019d and FAA Std-020b.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Apache Grounding; Nashville Wire Products.
 - 2. Boggs: H. L. Boggs & Co.
 - 3. Erico Inc.; Electrical Products Group.
 - 4. ILSCO.
 - 5. Kearney.

6. Korns: C. C. Korns Co.
7. Lyncole XIT Grounding.
8. Salisbury: W.H. Salisbury & Co.
9. Thomas & Betts, Electrical.
10. Utilco Co.

2.2 GROUNDING AND BONDING PRODUCTS

- A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.3 WIRE AND CABLE GROUNDING CONDUCTORS

- A. Comply with Section 16120 "Wires and Cables." Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
 1. Material: Copper. Use only copper wire for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
 2. Size: Minimum allowable size shall not be less than #12 AWG, in addition to compliance with NEC.
- B. Equipment Grounding Conductors: Insulated with green color insulation.
- C. Single-point Grounding Conductors: Insulated, color shall be green with a bright yellow tracer.
- D. Multi-point Grounding Conductors: Insulated, color shall be green with bright orange.
- E. Grounding-Electrode Conductors: Stranded cable.
- F. Underground Conductors: Bare, tinned, stranded, except as otherwise indicated.
- G. Bare Copper Conductors: Conform to the following:
 1. Solid Conductors: ASTM B3.
 2. Assembly of Stranded Conductors: ASTM B8.
 3. Tinned Conductors: ASTM B33.

2.4 MISCELLANEOUS CONDUCTORS

- A. Grounding Bus: Bare, annealed-copper bars of rectangular cross section. Size as indicated on drawings.
- B. Braided Bonding Jumpers: Copper tape, braided No. 3/0 AWG bare copper wire, terminated with copper ferrules.
- C. Raceway Bonding Jumpers: Copper, minimum size #6 AWG unless otherwise noted.

2.5 CONNECTOR PRODUCTS

- A. Exothermic-Welded Connections: Provided in kit form and selected per manufacturer's written instructions for specific types, sizes, and combinations of conductors and connected items.

2.6 GROUNDING ELECTRODES AND ACCESS WELLS

- A. Grounding Rods: Grounding rods shall be copper or copper-clad steel, a minimum of 10 ft. in length and 3/4 inch in diameter. Rod cladding shall not be less than 1/64 inch thick. Sectionalized type or exothermic butt welded rods shall be used when deeper earth penetration is required.
- B. Access Wells: Access wells are permissible at facilities. Locate wells as indicated on drawings. Access wells shall be made from poured concrete, and have a removable cover. The access well shall have a minimum opening area of 175 square inches, and be of sufficient size to allow ground rod connections to be readily disconnected and reconnected. Disconnectable connections to ground access well shall be made using mechanical ground rod clamps. All other connections shall be by exothermic weld process.

2.7 ELECTRONIC SINGLE POINT GROUND SYSTEM REQUIREMENTS:

- A. General: The electronic single point ground system shall be isolated from the electronic multipoint ground system, power grounding system, and lightning protection system. The electronic single point ground system shall be terminated at the main ground plate, or to the earth electrode system. The network shall be configured to minimize cable lengths. Conductive loops in the network shall be avoided by maintaining a trunk and branch arrangement.
- B. Ground Plates: Main, branch, and feeder ground plates shall be of copper, and dimensioned as indicated on drawings. The plates shall be mounted on phenolic or other non-conductive material of sufficient cross section to rigidly support the plates after all cables connected. Bolts or other devices used to secure the plates in place shall be insulated, or shall be of a non-conducting material. The plates shall be mounted in a manner that provides ready-accessibility for future inspection and maintenance.
- C. Isolation: The minimum resistance between the electronic single point ground and the electronic multipoint ground systems shall be 10 megohms. The resistance shall be measured after the complete network is installed and before connection to the earth electrode system or to the electronic SRG system at the main ground plate.
- D. Resistance: The maximum resistance between any ground plate and any cable connected to the plate shall not be greater than 1 milliohm.

2.8 ELECTRONIC MULTI-POINT GROUND SYSTEM:

- A. General: The electronic multi-point ground system is a network which provides multiple low resistance paths between various parts of the facility, between electronic equipment (chassis) within the facility, and between points within the facility and the earth electrode system. This system minimizes the effects of noise currents, and controls static charge build up.
- B. Ground Plates: Same as Electronic Single-Point ground plates.

2.9 POWER DISTRIBUTION SYSTEM GROUNDING:

- A. The facility electrical grounding shall comply with FAA 6950.10a, FAA-STD-019d, and National Electric Code (NEC). The Electronic Grounding systems shall not replace or be used in lieu of the Power Distribution System grounding conductors.
- B. Where one facility receives its electrical power from another facility, the equipment grounding conductor shall be carried in the same conduit or raceway with the phase and neutral conductors feeding the facility. The grounded (neutral) conductor shall not be grounded in the receiving facility.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Materials procured and installed in this Section shall be in accordance with FAA C-1217f, FAA Std-019d, FAA Std-020b, and FAA Order 6950.19a.
- B. Equipment Grounding Conductors: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes, or more conductors than required by NEC are indicated.
 - 1. Install green, equipment grounding conductor with all feeder and branch circuit conductors.
 - 2. Busway Supply Circuits: Install separate green, equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding-bar terminal on busway.
 - 3. Computer Outlet Circuits: Install separate equipment grounding conductor in branch circuit runs from power panels serving computer loads or power distribution units.
 - 4. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and above, including air cleaners and heaters. Bond conductor to each unit and to air duct.
 - 5. Water Heater, Heat-Tracing, and Antifrost Heater Circuits: Install a separate equipment grounding conductor to each electric water heater, heat-tracing assembly, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
 - 6. Aluminum Cable Tray: Provide bimetal connectors between the aluminum cable tray sections and the grounding system.
- C. Signal and Communication Systems: For telephone, fire alarm, security, voice, and data systems, provide a #4 AWG minimum insulated grounding conductor in raceway from grounding-electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- D. Separately Derived Systems: Where NEC requires grounding, ground according to NEC Paragraph 250-26.
- E. Metal Poles Supporting Outdoor Lighting Fixtures: Ground pole to a grounding electrode in addition to separate equipment grounding conductor run with supply branch circuit.
- F. Connections to Lightning Protection System: Bond grounding conductors, including grounding-conductor conduits, to lightning protection down conductors or lightning protection grounding

conductors in compliance with NFPA 780. Bond conductors across flexible A/C ductwork connections.

- G. Common Ground Bonding with Lightning Protection System: See Section 16670, "Lightning Protection."
- H. Grounding Bushing: Provide a grounding bushing for rigid steel conduit entering or leaving a manhole/handhole. Provide for power cable and spare conduit.
- I. Conduit or cable shields shall not be used as the equipment grounding conductor.

3.2 INSTALLATION

- A. Materials procured and installed in the Section shall be in accordance with FAA C-1217f, FAA Std-019d, FAA Std-020b, and FAA Order 6950.19a.
- B. General: The grounding requirements exceed those of the NEC. Grounding system shall be as indicated on the contract drawings and as specified herein. Reference IEEE-1100-1992, "Recommended Practice for Powering and Grounding Sensitive Electronic Equipment," when installing equipment. In no case shall the NEC be violated.
- C. Electrical Room Grounding Bus: Space 4 inches from wall, and support from wall 12 inches above finished floor, except as otherwise indicated.
- D. Ground Rods: Install ground rods as follows:
 - 1. Spacing: Ground rods shall be as widely spaced as practical, and in no case spaced less than one rod length apart. nominal spacings between rods should be between two and three times rod length.
 - 2. Depth of rods: Tops of vertically-driven ground rods shall be not less than 1 foot below grade level.
 - 3. Location: Ground rods shall be located 2 to 6 feet outside the foundation or exterior footing of the structure. On buildings with overhangs, ground rods may be located further out.
- E. Grounding Electrode Conductor: The grounding electrode conductor shall be bare or insulated copper, and shall be sized as shown in the contract documents. When not indicated in the contract documents, the conductor shall be copper and sized in accordance with NEC Table 250-94, "Grounding Electrode Conductor for AC Systems," except that the conductor shall not be smaller than No. 6 AWG. Where the grounding electrode conductor is routed through a metal raceway, the raceway shall be electrically continuous and bonded to the conductor at each end. The grounding electrode conductor shall be bonded to the earth electrode system with an exothermic welded joint. For a separately derived system such as an isolation transformer, the grounding electrode conductor shall be connected in accordance with the NEC. This conductor shall be permitted to terminate by exothermic welding to an equipment room's perimeter ground cable under a raised floor.
- F. Grounding Conductors: Route along the shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

- G. Earth Electrode System: Ground rods shall be interconnected by a buried, bare, No. 4/0 AWG stranded copper cable. The cable shall be buried at least 2'-6" below grade level. Connections to the ground rods shall be made by exothermic welding. The interconnecting cable shall close on itself, forming a complete loop, with the ends exothermically welded. The structural steel of buildings shall be connected to the earth electrode system, as indicated on drawings, with a bare, No 4/0 AWG stranded copper cable. Connections shall be by exothermic welds. The grounding electrode conductor for the electric service, sized in accordance with the NEC requirement for grounding electrode conductors, shall be connected to a ground rod in the earth electrode system with an exothermic weld. All underground metallic pipes and tanks, and the telephone ground, shall be connected to the earth electrode system by a copper cable no smaller than No. 2 AWG. Where routed underground, interconnecting cables shall be bare. Exothermic welds shall not be used where hazards exist, i.e. near fuel tanks. In these cases, connections using COR-approved pressure connectors will be allowed. Bonding resistance of all interconnections shall be one (1) milliohm or less for each bond, when measured with a 4-terminal milliohm meter.
- H. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding-clamp connectors.
- I. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
- J. Access Wells: Provide for driven grounding electrodes, as indicated. Set top of well flush with finished grade or floor. For gravel fill, see drawing detail.
- K. Fault Protection: Prevent equipment parts subject to human contact during operation and maintenance from being electrically energized when powerline faults or components fail. Ground parts with a low impedance path to the chassis or cabinets in which they are mounted.
1. Instances of power supplied to electronic equipment through a cable and connector, and the connector has a pin to continue the equipment grounding conductor,

3.3 CONNECTIONS

- A. Materials procured and installed in the Section shall be in accordance with FAA C-1217f, FAA Std-019d, FAA Std-020b, and FAA Order 6950.19a.
- B. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

- D. Terminate insulated equipment grounding conductors for feeders with pressure-type grounding lugs. Where metallic raceways terminate at non-metallic or non-conductive housings, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors .
- E. Raceway Grounding: Surface metal raceways, wireways, or cable rack systems shall be installed in a manner that assures electrical continuity. Insulated copper bonding jumpers shall be installed between adjacent raceway sections to assure proper bonding. Uninsulated conductors shall not be used. Unless otherwise indicated, the minimum size for these bonding jumpers shall be No. 6 AWG. All metallic raceway penetrations into a facility structure shall be bonded to the earth electrode system.
- F. Other Grounding Systems: Any additional grounding systems used for electronic equipment shall be connected directly to the exterior earth electrode system. See FAA Std-019d.
- G. Connections at Access Wells: Use crimped pressure connectors on conductors and make welded connections between conductors and grounding rods.
- H. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A.
- I. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Mechanical connections using a Burndy "Hyground Connector" or equipment when operated at a force of 24,000 pounds are acceptable as FAA approved pressure connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on ground conductor. Hydraulically crimped connectors are not acceptable in a lightning protection system.
- J. Single Point Ground Interconnections:
 - 1. All connections to the single point ground system shall be made on ground plates.
 - 2. Labeling: The single point ground system shall be clearly labeled to preserve its integrity, as described in the following sections.
 - 3. Cables: Trunk, branch, and electronic equipment ground cables shall be color coded green with a bright yellow tracer. Where cables are concealed and not color coded, any exposed portion of the cable and each end of the cable for a minimum length of 2 feet shall be color coded by green tape overlaid with bright yellow tape to form the tracer. Where routed through raceways or wireways, color coding shall be visible by opening any cover. Where conductors are routed through cable trays, color coding 4 inches in length shall be applied at intervals not exceeding 3 feet.
 - 4. Ground plates: All ground plates shall be provided with a clear plastic protective cover spaced 3/4 inch from the plate, and extending 1 inch beyond each edge. This cover shall have a green label with distinguishing bright yellow slashes attached, bearing the words: "CAUTION. ELECTRONIC SINGLE POINT GROUND." in black 3/8-inch high characters.
- K. Multi-Point Ground Interconnections:
 - 1. All connections to the multi-point ground system shall be made on ground plates.

2. Labeling: The multi-point ground system shall be clearly labeled to preserve its integrity, as described in the following sections.
3. Cables: Trunk, branch, and electronic equipment ground cables shall be color coded green with a bright orange tracer. Where cables are concealed and not color coded, any exposed portion of the cable and each end of the cable for a minimum length of 2 feet shall be color coded by green tape overlaid with bright orange tape to form the tracer. Where routed through raceways or wireways, color coding shall be visible by opening any cover. Where conductors are routed through cable trays, color coding 4 inches in length shall be applied at intervals not exceeding 3 feet.
4. Ground plates: All ground plates shall be provided with a clear plastic protective cover spaced 3/4 inch from the plate, and extending 1 inch beyond each edge. This cover shall have a green label with distinguishing bright orange slashes attached, bearing the words: "CAUTION. ELECTRONIC MULTI-POINT GROUND." in black 3/8-inch high characters.

3.4 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- A. Handholes: Install driven ground rods close to building perimeter wall and set rod depth so 4 inches will extend above finished floor of handhole. Where necessary, install ground rod before handhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from grounding rod into handhole through a waterproof sleeve in handhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.
- B. Grounding System: Ground pad-mounted equipment and non-current-carrying metal items associated with handholes by connecting them to underground cable and grounding electrodes, arranged as indicated.

3.5 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Engage an independent electrical testing organization to perform tests described below. Ensure no connection to utility power is made during testing.
- B. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground access wells. Measure ground resistance not less than 2 full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the 2-point method in accordance with Section 9.03 of IEEE 81.
- C. Ground resistance maximum values shall be as follows:
 1. Equipment Rated 500 KVA and Less: 10 ohms.
 2. Equipment Rated 500 to 1000 KVA: 5 ohms.
 3. Equipment Rated More than 1000 KVA: 5 ohms.
 4. Unfenced Substations and Pad-Mounted Equipment: 5 ohms.
 5. Handhole Grounds: 10 ohms.
- D. Earth Electrode System Ground shall not exceed 5 ohms.
- E. Report: Prepare test reports, certified by the testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

END OF SECTION 16452

SECTION 16470 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V and less.

1.2 REFERENCED STANDARDS

- A. Federal Aviation Administration (FAA)

- 1. C-1217f Electrical Work, Interior
 - 2. Std-019d Lightning Protection, Grounding, Bonding, and Shielding Requirements for Facilities
 - 3. Std-020b Transient Protection, Grounding and Shielding for Electronic Equipment

- B. Federal Specification (FS)

- 1. W-P-115 - Panel, Power Distribution

- C. Institute of Electrical and Electronic Engineers (IEEE)

- 1. C62.41 Recommended Practice on Surge Voltage in Low-Voltage AC Power Circuits

- D. National Electrical Manufacturers Association (NEMA)

- 1. 250 Enclosures for Electrical Equipment (1000 Volts or Less)
 - 2. PB1 Panel Board
 - 3. AB1 Molded Case Circuit Breakers and Molded Case Switches

- E. Inter National Electrical Testing Association (NETA)

- 1. ATS Acceptance Testing Specification for Electric Power Distribution Equipment and Systems.

- F. National Fire Protection Association (NFPA).

- 1. 70 National Electrical Code (NEC)

- G. National Institute of Standards and Technology (NIST)

- H. Occupational Safety and Health Administration (OSHA)

- 1. 29CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL).

- I. Underwriters' Laboratories (UL)

- 1. 50 Electrical Cabinets and Boxes
 - 2. 67 Panelboards

3. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.
4. 489 Molded Case Circuit Breakers and Circuit Breaker Enclosures.

1.3 SUBMITTALS

- A. Product Data: For each type of panelboard, accessory item, and component specified.
- B. Shop Drawings: For panelboards. Include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:
 1. Enclosure type with details for types other than NEMA 250, Type 1.
 2. Bus configuration and current ratings.
 3. Short-circuit current rating of panelboard.
 4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Include certified infrared scanning reports.
- E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- F. Maintenance Data: For panelboard components included in the maintenance manuals specified in Section 16050. Include manufacturer's written instructions for testing circuit breakers.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1910.7, or shall be a full member company of NRTL.
 1. Testing Agency's Field Supervision: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3 of this section.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.
- C. Comply with NFPA 70, "National Electrical Code."
- D. Comply with NEMA PB 1, "Panelboards."
- E. Single Source Responsibility: Panelboards and circuit breakers located in the panelboards shall be the product of a single manufacturer.

1.5 EXTRA MATERIALS

- A. Keys: 6 spares of each type for panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials procured and installed in this Section shall be in accordance with FAA C-1217f, FAA Std-019d, and FAA Std-020b.

2.2 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Eaton Corp.; Westinghouse & Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Div.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D Co.

2.3 PANELBOARD FABRICATION

- A. Panelboards shall be circuit breaker equipped, dead-front type, and shall conform to Federal Specification W-P-115, Type I, Class 1.
- B. Enclosures: UL 50, galvanized steel, flush- or surface-mounted cabinets as indicated. Panelboards shall be listed and labeled by Underwriters Laboratories, Inc. in accordance with UL Standard 67, and shall conform to the latest requirements of the National Electric Code and of NEMA Standard PB 1, Type 1, Class 1, unless otherwise indicated to meet environmental conditions at installed locations.
- C. Directory Frame: Metal, mounted inside each panelboard door.
- D. Bus: Hard drawn copper of 98 percent conductivity meet UL 67 temperature rise limits, and have a current density of 1000 amperes per square inch. Bus bars shall be sequenced-phased, and rigidly supported by high impact resistant, insulated bus supporting assemblies to prevent vibration or short circuits. Solderless terminations shall be suitable for copper UL listed wire or cable and shall be tested and listed in conjunction with appropriate UL standards.
 - 1. Phase bus bars shall be copper or plated copper.
 - 2. Neutral bus bar shall be copper or plated copper, and insulated from panelboard.
 - 3. Capacity as indicated on Drawings, or equal to or greater than the panelboard OCPD.
- E. Main and Neutral Lugs: Compression type.
 - 1. The neutral bar shall be fully rated and capable of being located in either corner of the enclosure at the line end to facilitate conductor termination and shall be insulated from panelboard. Provide 200% rated neutral for panelboards supplying power to non-Linear loads as shown on Drawings.
- F. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors with 25% additional spaces for future conditions. Lugs shall be sized to accommodate grounding conductors shown on plans.
 - 1. The ground bus shall be securely bonded to the cabinet and shall be separate from the neutral bus.
 - 2. The number of terminations shall be equal to the number of poles in the panelboard.

3. The ground bus bar shall be structurally integral to the panelboard, or attached to the panelboard with a bolt, nut, and lock washer.
 - a. If ground bus bar is mounted to enclosure with screw threads only, (i.e. tapped blind hole), a separate bolted ground lug shall be installed on the panelboard and bonded to the ground bus bar.
 1. Bond conductor shall have same current carrying capacity as the largest equipment grounding conductor terminated to the ground bus bar.
 - G. Short circuit rating: Panelboards shall be fully rated in AIC. See Drawings for AIC rating.
 - H. Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the overcurrent protective device ampere ratings indicated for future installation of devices.
 - I. Include the following special features for panelboards.
 1. Hinged Front Door in Door Construction: Entire front trim hinged to box with standard door within hinged trim cover. (One piece front with two doors). The smaller door, when open, provides access to device handles and rating labels and shall be lockable. The larger door, when open, provides access to conductors and wiring terminals. Door hinges shall be continuous piano hinges which are welded to the door(s) and bolt on front.
 - a. All door hinges shall be concealed.
 2. Channel/Wiring Space: Shall be four (4) inches wide for power feeders up to and including 100 amperes, six (6) inches wide for power feeders over 100 amperes and up to 225 amperes, and eight (8) inches wide for power feeders over 225 amperes and up to 600 amperes.
 3. Skirt for Surface-Mounted Panelboards: Same gauge and finish as panelboard front with flanges for attachment to panelboard, wall, and floor.
 4. Subfeed: Over current protective device or lug provision.
 - J. Doors shall have flush type cylinder locks and latches. All locks in a project shall be keyed alike, and 2 keys shall be furnished with each lock.
- 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS
- A. Branch Over current Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units. Branch circuit breakers shall be molded case quick-make, quick-break with short circuit interrupting current rating equal to or greater than the rating indicated on the Drawings.
 1. Branch circuits shall be connected to the individual circuit breakers as indicated on the Drawings.
 - B. Branch-circuit Breakers: Bolt-on type.
 - C. Doors: In panelboard front, with concealed hinges. Secure with flush latch and tumbler lock, keyed alike, and two (2) keys shall be provided with each lock.
- 2.5 DISTRIBUTION PANELBOARDS

- A. Doors: In panelboard front, with concealed hinges. Secure with flush latch and tumbler lock, all keyed alike and two (2) keys shall be provided with each lock.
- B. Branch-Circuit Breakers: Bolt-on type.
- C. Devices with an adjustable magnetic trip shall be factory set to the "Low" value.

2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, UL 489, FS W-C-375 and the following requirements.
 - 1. Molded case
 - 2. Bolt-on breaker type. Stab-in and plug-in types are not acceptable.
 - 3. Quick make, quick break connections with mechanical trip free switching mechanism
 - 4. Inverse time, thermal overcurrent trip;
 - 5. Instantaneous magnetic trip;
 - 6. Thermal trip calibrated for 40 deg C ambient temperature;
 - 7. Provide breakers with number of poles, voltage rating, current rating, and frame size as indicated on the drawings.
 - 8. Multiple circuit breakers shall have an internal, common trip mechanism;
 - 9. Trip-indicating feature;
 - 10. Single-pole breakers shall be full size modules;
 - 11. Two and three pole breakers shall be sized in multiples of a single-pole breaker;
 - 12. Branch circuits shall be connected to the individual circuit number, as indicated on the Drawing; and
 - 13. UL marked as suitable for use with 75 deg C wire.
 - 14. Shunt Trip: Where indicated. 120V. 60HZ.
- B. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices and interrupting capacity rating to meet available fault current as indicated on the Drawings.
 - 1. Minimum rating: 10,000 AIC.
 - 2. Circuit breaker ratings shall be in accordance with the SCA/PDC study, FAA Order 6950.27.
- C. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.
- D. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
- E. Solid State: Adjustable, solid-state or microprocessor-controlled circuit breakers shall have adjustments readily accessible and visible from the front of the panelboard, after installation. Individual circuit breaker frame size shall not exceed the panelboard bus rating.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.

- B. Portable Test Set: Arranged to permit testing of functions of solid-state trip devices without removal from panelboard.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with manufacturer's requirements in accordance with the direction of the COR.

3.2 INSTALLATION

- A. Install panelboards and accessory items according to NEMA PB 1.1.
- B. Mounting Heights, top of trim: 74 inches above finished floor, unless otherwise indicated. Panelboards with a height greater than 90 inches shall be mounted at height required for working clearances.
- C. Mounting: Plumb and rigid without distortion of box. Mount flush panelboards uniformly flush with wall finish.
- D. Circuit Directory: Type directory to include installed circuit loads after balancing panelboard loads. The directory shall be arranged so that typed entries simulate circuit breaker positions in the panelboard. Obtain approval before installing.
- E. Install filler plates in unused spaces.
- F. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch GRC (Galvanized Rigid Conduit) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch GRC empty conduits into raised floor space of below slab not on grade.
- G. Wiring in Panelboard Gutters: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Identify field-installed wiring and components and provide warning signs as specified in, Section 16195 "Electrical Identification."
- B. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws.

3.3 GROUNDING

- A. Make equipment grounding connections for panelboards as indicated, and in accordance with, Section 16452 "Grounding."
- B. Provide ground continuity to main electrical ground bus as indicated.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Make insulation-resistance tests of each panelboard bus, component, and connecting supply, feeder, and control circuits.
 - 2. Make continuity tests of each circuit.
- B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA, ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.
- C. Infrared Scanning: Before CAI, but not more than two (2) months after Final Acceptance, perform an infrared scan of each panelboard. Remove fronts to make joints and connections accessible to a portable scanner. Scan panelboards with the maximum available load at each panel.
 - 1. Instrument: Use an approved infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record for device used.

3.6 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt and debris. Touch up scratches and marred finishes to match original finish.

END OF SECTION 16470

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SECTION 16515 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes interior lighting fixtures, lamps, ballasts, emergency lighting units, and accessories.

1.2 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

- 1. C62.41 Recommended Practice on Surge Voltage in Low-Voltage AC Power Circuits
- 2. C78 Electric Lamps
- 3. C82.2 Fluorescent Lamp Ballast, Methods of Measurement
- 4. C82.4 Ballast for High-Intensity-Discharge Sodium Lamps

B. Federal Specifications (FS)

- 1. W-L-305 Light Set, Emergency
- 2. W-F-414 Fixture, Lighting, Fluorescent
- 3. J-C-30 Cable and Wire, Electrical

C. Federal Aviation Administration (FAA)

- 1. C-1217f Electrical Work, Interior
- 2. Std-019d Lightning Protection, Grounding, Bonding, and Shielding Requirements for Facilities
- 3. Std-020b Transient Protection, Grounding and Shielding for Electronic Equipment

D. Military Standards

- 1. MIL STD 461 Requirements for Control of Electromagnetic Interference Emissions and Susceptibility User.

E. National Fire Protection Association (NFPA)

- 1. 70 National Electrical Code (NEC)

F. Occupational Safety and Health Administration (OSHA)

- 1. 29CFR 1910.7 Definitions and Requirements for a National Recognized Testing Laboratories (NRTL).

G. Underwriters Laboratories (UL)

- 1. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
- 2. 542 Lampholders, Starters, and Starter Holders for Fluorescent Lamps.
- 3. 924 Emergency Lighting and Power Equipment

4. 935 Fluorescent Lamps and Ballasts
5. 1029 High-Intensity-Discharge Lamps and Ballasts
6. 1570 Fluorescent Lighting Fixtures
7. 1571 Incandescent Lighting Fixtures
8. 1572 High-Intensity-Discharge Lighting Fixtures

1.3 DEFINITIONS

- A. Fixture: A complete lighting unit or exit sign. Fixtures include lamps and parts required to distribute light, position and protect lamps, and connect lamps to power supply.
- B. Average Life: The time after which 50 percent fails and 50 percent survives under normal conditions.
- C. Luminaire: Fixture.

1.4 SUBMITTALS

- A. Product Data describing fixtures, lamps, ballasts, and emergency lighting units. Arrange Product Data for fixtures in order of fixture designation. Include data on features and accessories and the following:
 1. Outline drawings indicating dimensions and principal features of fixtures.
 2. Electrical Ratings and Photometric Data: Certified results of independent laboratory tests for fixtures and lamps.
- B. Maintenance data for fixtures to include in the operation and maintenance manual.

1.5 QUALITY ASSURANCE

- A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL.
- B. Listing and Labeling: Provide fixtures and accessory components that are listed and labeled for their indicated use and installation conditions on the Project.
 1. Special Listing and Labeling: Provide fixtures for use in damp or wet locations, underwater, and recessed in combustible construction that are specifically listed and labeled for such use. Provide fixtures for use in hazardous (classified) locations that are listed and labeled for the specific hazard.
 2. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 3. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.
- C. Ballast Manufacturer Qualifications: Manufacturer shall have manufactured ballasts for at least ten years.
- D. Coordinate fixtures, mounting hardware, and trim with ceiling system and other items, including work of other trades, required to be mounted on ceiling or in ceiling space.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Lamps: 1 lamp for every 10 of each type and rating installed. Furnish at least one of each type.
 - 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Wire Guards: 1 for every 50 of each type installed. Furnish at least one of each type.

1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty - Ballasts: Provide a written warranty signed by manufacturer and Installer agreeing to replace ballasts against defects in material or workmanship for a period of five years from the date of Substantial Completion. Defective ballasts shall be replaced within the warranty period at no cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials procured and installed in this Section shall be in accordance with FAA C-1217f, FAA Std-019d, and FAA Std-020b.

2.2 FIXTURES, GENERAL

- A. Comply with the requirements specified in the Articles below and lighting fixture schedule indicated on the drawings.
- B. The fixtures specified in the lighting fixture schedule on the Drawings establish a level of quality and appearance that any substituted fixtures must match or exceed. Substitutions for the specified fixtures will be reviewed by the Engineer for compliance and approval.
- C. All lighting fixtures shall be UL approved and shall bear the UL label.

2.3 FIXTURE COMPONENTS, GENERAL.

- A. Metal Parts: Free from burrs and sharp corners and edges.
- B. Sheet Metal Components. Steel, except as indicated. Components are formed and supported to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses,

diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

D. Reflecting Surfaces: Minimum reflectance as follows, except as otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or water white, annealed crystal glass, except as otherwise indicated.

1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Lens Thickness: 0.125 inch minimum; except where greater thickness is indicated.

F. Fixture wiring shall be thermoplastic insulated copper, rated for 600 volts, in accordance with F.S. J-C-30 and the NEC.

G. Flexible metal conduit, minimum 3/8 inch nominal trade size is permitted.

2.4 SUSPENDED FIXTURE SUPPORT COMPONENTS.

A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.

B. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.

C. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

D. Hook Hanger: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.5 FLUORESCENT FIXTURES.

A. Fixtures conform to UL 1570, "Fluorescent Lighting Fixtures."

B. Ballasts: Conform to UL 935, "Fluorescent-Lamp Ballasts."

1. Certification: By Electrical Testing Laboratory (ETL).
2. Labeling: By Certified Ballast Manufacturers Association (CBM).
3. Type: Class P. high-power factor type except as indicated otherwise.
 - a. Shall include inherent automatic thermal reset and fuse.
 - b. Shall be type for use in indoor or type 1, outdoor applications
4. Sound Rating: A rating, except as indicated otherwise.
5. Voltage: Match connected circuits.

- C. Low Temperature Ballast Minimum Starting Temperature: Minus 0 degrees F.
- D. Electronic Ballasts: Solid-state, full-light-output, energy-saving type compatible with T8 lamps. Conform to FCC regulations Part 15, Subpart J. for electromagnetic interference. Conform to ANSI C62.41, "Guide for Surge Voltages in Low-Voltage AC Power Circuits," Location Category A2, for resistance to voltage surges for normal and common modes.
 - 1. Minimum Power Factor: 90 percent.
 - 2. Minimum Operating Frequency: 20,000 Hz.
 - 3. Third Harmonic Content of Ballast Current: Less than 15 percent.
 - 4. Total Harmonic Distortion (THD): Less than 20 percent.
 - 5. Average Input: The minimum required wattage when tested according to ANSI C82.2, "Fluorescent Lamp Ballasts, Methods of Measurement" shall be as indicated on the lighting fixture schedule.
 - 6. Ballasts shall operate the lamps in parallel.
 - 7. Ballasts shall be fully encapsulated to ensure maximum thermal and structural integrity.
- E. Dimming Ballasts: Solid state, full light output with dimming range of 100% to 1 % continuous light output. Conform to IEEE C62.41, "Guide for Surge Voltages in Low Voltage AC Power Circuits," Category A, for resistance to voltage surges.
 - 1. Minimum Power Factor: 95 percent.
 - 2. Minimum Operating Frequency: 20,000 hertz without visible flicker.
 - 3. Maximum Crest Factor: 1.4.
 - 4. Ballast Dimming Circuitry shall be class 2 and fully isolated from ballast input power.
 - 5. Ballast shall maintain constant light output over operating ranges of 200 volts to 320 volts (277V ballasts) 60 Hz.
 - 6. Ballast shall require no intermediate trimming controls between ballast and controlling device.
 - 7. Ballast case temperature shall not exceed 25 degree C. temperature rise over 40 degree C. ambient.
- F. Electromagnetic Interference (EMI) Filters: Integral to fixture assembly. Provide one filter for each ballast. Suppress EMI as required by MIL-STD-461.
- G. Lamp holders shall have silver plated contacts, and shall conform to UL 542.
- H. Recessed Fixtures: Recessed fluorescent fixtures shall have adjustable fittings to permit alignment with ceiling panels.
- I. Suspended Fixtures: Pendant mounted fluorescent fixtures shall conform to FS W-F-414 and shall be types indicated on the Drawings.

2.6 HIGH INTENSITY DISCHARGE (HID) FIXTURES

- A. Fixtures: Conform to UL 1572.

- B. HID Ballasts: Conform to UL 1029 "High-Intensity Discharge Lamp Ballasts," and ANSI C82.4. "Ballasts for High-Intensity-Discharge Sodium lamps (Multiple Supply Type). Provide ballast with the following features, except as otherwise indicated:
1. Constant wattage auto-transformer (CWA) or regulating high-power-factor type, unless otherwise indicated.
 2. Operating Voltage: Match system voltage.
 3. Single-Lamp Ballasts: Minimum starting temperature of minus 30 deg C.
 4. Normal Ambient Operating Temperature: 40 deg C.
 5. Open circuit operation will not reduce average life.
 6. High-Pressure Sodium (HPS) Ballasts: Equip with a solid-state igniter/starter having an average life in pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 deg C.
 7. Noise Suppressors: Manufacturer's standard epoxy-encapsulated model designed to minimize audible fixture noise.
 8. HID lamps installed indoors shall be "self-extinguishing type."
- C. Auxiliary, Instant-On, Quartz System: Automatically switches quartz lamp when fixture is initially energized and when momentary power outages occur. Turns quartz lamp off automatically when HID lamp reaches approximately 60 percent light output. Ballast has internal components independent of the incoming line voltage.

2.7 INCANDESCENT FIXTURES.

- A. Conform to UL 1571, "Incandescent Lighting Fixtures."

2.8 EXIT SIGNS.

- A. Conform to UL 924 "Emergency Lighting and Power Equipment," and the following:

1. Sign Colors: Conform to local code.
2. Minimum Height of Letters: Conform to local code.
3. Arrows: Include as indicated.
4. Lamps for AC Operation: Light emitting diode (LED) array.

2.9 INDIRECT FLUORESCENT LIGHTING

- A. Fixtures shall be low profile, high efficiency type with wide light distribution pattern having the following performance characteristics; performance shall be verifiable by independent testing laboratories, including:
1. Fixture efficiency shall not be less than 83 percent.
 2. Maximum candela output shall be in the 124 to 126 degree zone and shall not be less than 600 candelas for a single lamp fixture.
 3. Maximum candela at 180 degrees shall not exceed 475 candelas for a single lamp fixture.
 4. No less than 51 percent of total fixture lumens shall be emitted in the 90 to 130 degree vertical zone.
 5. Provide ceiling luminance (brightness) ratios between 3:1 and 4:1 (maximum to minimum), with point-by-point computer generated calculations at one (1) foot intervals for entire room.
 6. Provide indirect illuminance level of 35.

7. Provide light meter similar to Model "Digital Light Meter, manufacturer: DLMI.

2.10 LAMPS

- A. Furnish lamps for all fixtures in accordance with the lighting fixture schedule.
- B. Conform to ANSI C78 series applicable to each type of lamp.
- C. Fluorescent Color Temperature and Minimum Color-Rendering Index (CRI): 3500 K and 85 CRI, except as otherwise indicated.
- D. Metal Halide Color Temperature and Minimum Color-Rendering Index (CRI): 3600 K and 70 CRI, except as otherwise indicated.
- E. Incandescent lamps shall be rated for 130 volts unless otherwise indicated.

2.11 FINISHES

- A. Manufacturer's standard finish applied over corrosion-resistant treatment or primer, free of streaks, runs, stains, blisters, and similar defects. Remove fixtures showing evidence of corrosion during project warranty period and replace with new fixtures.

2.12 EMERGENCY LIGHTS

- A. Emergency lights shall conform to FS W-L-305, Type I, Class 1, Style D or E, with the number of heads as indicated on the Drawings.

2.13 COLD CATHODE SYSTEMS GENERAL REQUIREMENTS

- A. Known acceptable source: Neon & Cathode Systems, Inc.
8320 Queenair Drive
Gaithersburg, MD 20879
PH: 301-921-4120 FAX: 301-963-3050
- B. Manufacturer shall be listed under UL/IFAY "Electric Discharge Lighting Systems Over 1000 Volts". Sign company and neon shop fabricators are not acceptable substitutes.
- C. Lamp Electrical Data: 25MM cold cathode lamps operating on 277 volt/ 120 milliamp NPF Transformers:

VA per foot: 7.5
AMPS per foot: .03
WATT consumption per foot: 4.0
Lumens per foot (3500 TC): 374
- D. Indoor Cold Cathode System Specification
 1. Transformers: UL listed 277 volts/60 Hz NPF remote transformer in steel NEMA 1 enclosure with secondary 100 milliamp operating current, mid-point ground design with voltage as required

- by lamp footage and dimming requirements. Mount transformers in accessible locations not to exceed 100 degree F ambient temperature.
2. Lampholders: Model # RSE and RSI, UL listed 7500 volt glazed white porcelain with beryllium copper contacts.
 3. Lamps: 25 MM 3500 soft white triphosphor 374 lumens per foot. Manufacturer shall provide ITL photometric reports, color shall be deep blue.
 4. Secondary Feeds: UL listed 15,000 volt GTO cable in listed conduit. Conduit length must not exceed 20-feet (EMT). One cable per conduit. Conduits must maintain a six inch separation from each other and must be kept at least 24 inches from computer, telephone or public address system wiring or equipment.

E. Outdoor Cold Cathode System Specifications

1. Transformers: UL listed 277 volt/60 Hz remote transformer in steel NEMA 1 enclosure with secondary 100 milliamp operating current, mid-point ground design with voltage as required by lamp footage and dimming requirements. Transformer to be located in an indoor dry location not to exceed 100 degrees F.
2. Lampholders: UL listed G-cup, 7500 volt wet location.
3. Lamps: 25MM deep blue.
4. Secondary Feeds: UL listed 15,000 volt GTO cable in listed conduit. Conduit length must not exceed 20 feet (EMT). Any conduit exposed to the weather must be waterproof rigid or flexible liquid tight. Transition from conduit to G-cup lamp electrode shall be accomplished via UL listed wet location Absco conduit plug assembly. One cable per conduit. Conduits must maintain a six inch separation from each other and must be kept at least 24 inches from computer, telephone or public address system wiring or equipment.

PART 3 - EXECUTION

3.1 GENERAL

- A. Materials procured and installed in this Section shall be in accordance with FAA C-1217f, FAA Std-019d, and FAA Std-020b.

3.2 INSTALLATION

- A. Set units plumb, square, and level with ceiling and walls, and secure according to manufacturer's written instructions and approved Shop Drawings.
- B. Support for Recessed and Semi-recessed Grid-Type Fluorescent Fixtures: Units shall not be solely supported from suspended ceiling support system. Install ceiling support system rods or wires at a minimum of 4 rods or wires for each fixture, located not more than 3 inches from fixture corners. In addition, each fixture shall be supported at each corner, with 12 gage drop ceiling hanger wire.
 1. Install support clips for recessed fixtures, securely fastened to ceiling grid members, at or near each fixture corner.
 2. Fixtures Smaller than Ceiling Grid: Install a minimum of 4 rods or wires for each fixture at corner of ceiling grid where fixture is located. Do not support fixtures by ceiling acoustical panels.

3. Fixtures of Sizes Less than Ceiling Grid: Center in acoustical panel. Support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
- C. Support for Suspended Fixtures: Brace pendants and rods over 48 inches long to limit swinging. Support stem-mounted, single-unit, suspended fluorescent fixtures with twin-stem hangers. For continuous rows, use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of chassis, including one at each end.
- D. Lamping: Lamp units according to manufacturer's instructions.
- E. Emergency lights shall be connected to the wiring system by a cord no more than 3 feet in length and a single receptacle.

3.3 CONNECTIONS

- A. Ground lighting units. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A. Ground fixtures in accordance with FAA C-1217f, paragraph 4.4.5.2.
- B. External bonding jumpers are not required across lighting fixture flexible conduit.

3.4 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Give advance notice of dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests: Verify normal operation of each fixture after fixtures have been installed and circuits have been energized with normal power source. Interrupt electrical energy to demonstrate proper operation of emergency lighting installation. All fixtures shall be energized upon completion of installation for a period of 72 hours, upon which contractor shall replace any lamps or ballasts which are not operating properly.
- E. Replace or repair malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.
- F. Report results of tests.
- G. Replace fixtures that show evidence of corrosion during Project warranty period.

3.5 ADJUSTING AND CLEANING

- A. Clean fixtures after installation. Use methods and materials recommended by manufacturer.
- B. Adjust amiable fixtures in the presence of the architect to provide required light intensities.

END OF SECTION 16515